CONSTRUCTION QUALITY ASSURANCE PLAN

ON-SITE DISPOSAL FACILITY

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Fernald Environmental Management Project
Fernald, Ohio

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Under

Fluor Daniel Fernald
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ACRONYM LIST

ALARA	As Low As Reasonably Achievable
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society of Testing and Materials
BAMR	Borrow Area Management and Restoration
CCM	Construction Manager
COE	Corps of Engineers
CQC	Construction Quality Assurance
CQC	Construction Quality Control
CS	Confirmatory Sampling
CSS	Construction Safety and Security
DCP	Design Criteria Package
DOE	United States Department of Energy
DOT	Department of Transportation
FDF	Fluor Daniel Fernald
FEMP	Fernald Environmental Management Project
FTMS	Federal Testing Method Standards
HDPE	High Density Polyethylene
IMP	Impacted Materials Placement
NSF	National Sanitation Foundation
O&M	Operations and Maintenance
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
OU1	Operable Unit 1
OU2	Operable Unit 2
OU3	Operable Unit 3
OU4	Operable Unit 4
OU5	Operable Unit 5
PE	Polyethylene
QA	Quality Assurance

QC	Quality Control
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SWMEC	Surface Water Management and Erosion Control
TPP	Test Pad Program
USEPA	United States Environmental Protection Agency
WAC	Waste Acceptance Criteria

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1. INTRODUCTION

1.1 Overview

This Construction Quality Assurance (CQA) Plan describes the quality assurance and construction quality control (CQC) activities that will be undertaken during construction of the On-Site Disposal Facility (OSDF) at the Fernald Environmental Management Project (FEMP) near Fernald, Ohio. The purpose of this document is to define the scope, formal organization, and procedures necessary to achieve a high level of quality in the OSDF and assure that OSDF components are constructed in compliance with the approved Construction Drawings and Technical Specifications. This plan addresses the CQA and CQC activities to be performed during construction of the OSDF.

The OSDF CQA plan will address the following elements of the OSDF construction:

- general earthwork;
- liner system;
- final cover system;
- leachate collection, leak detection, and transmission systems;
- electrical and mechanical work; and
- other general site work.

The quality assurance and quality control monitoring and testing procedures, along with the required frequency of tests, are provided. Also detailed in this plan are the organization and minimum qualifications the CQC personnel and other key parties to

be involved in the construction of the OSDF as well as the minimum standards for construction testing and documentation to assure quality.

1.2 Project Description

The design approach for the OSDF is presented in the document, "*Final Remedial Design Work Plan for Remedial Actions at Operable Unit 2*". The design of the OSDF, as currently developed, is presented in the "*Final Design Package, On-Site Disposal Facility*". The OSDF Design Criteria Package (DCP) component of the Final Design Package requires preparation of a CQA Plan to address, at a minimum, the following;

- construction of the double composite liner system;
- construction of the leachate management system;
- construction of the final cover system; and
- general site work including installation of various appurtenances such as general earthwork, mechanical and electrical systems, and concrete.

This CQA Plan presented in this document has been prepared to address these items and to satisfy the applicable requirements identified in Section 2 of this plan. The interface of the CQA Plan with other related plans is discussed in Section 1.6.

1.3 Major Components of the OSDF

The major components of the OSDF include the liner system, final cover system, leachate management system, surface-water management system, support elements, utilities, and temporary support facilities.

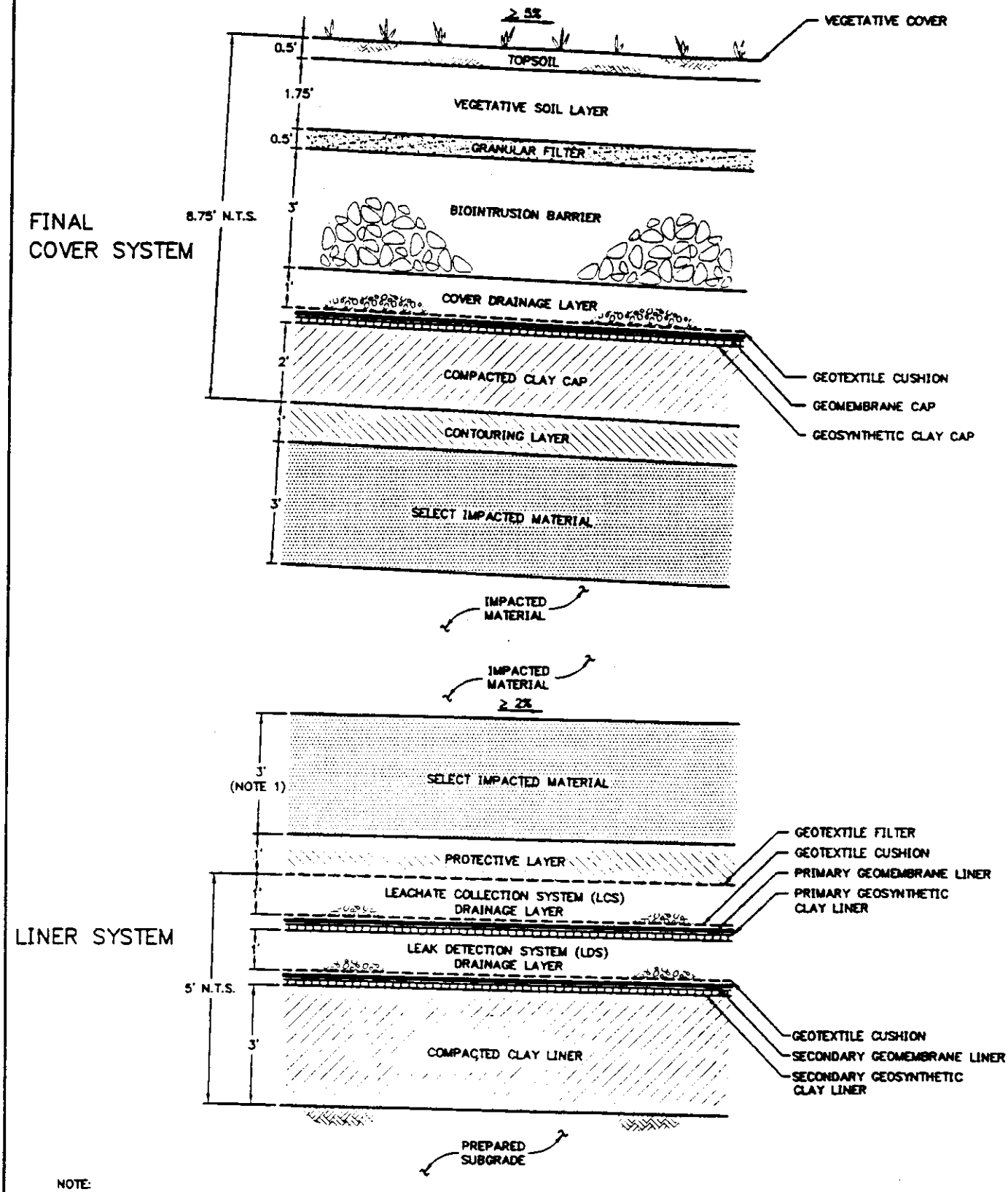
- *Liner and Final Cover Systems.* The liner and final cover systems will be constructed using both soil and geosynthetic components (refer to Figure 1-1). The liner system consists of a double-composite liner that will have a leachate collection system (LCS) above the primary liner and a leakage detection system (LDS) between the primary and secondary liners. The final cover system includes a composite cap overlain by the following layers: drainage layer; biointrusion barrier; granular filter layer; vegetative soil layer; and topsoil.

- *Leachate Management System.* The leachate management system collects leachate generated by the OSDF and conveys it to a treatment facility. Components of the leachate management system within the battery limit include: double-walled gravity drain pipes from each OSDF cell, detection and collection manholes, double-walled gravity transmission pipe, and permanent lift station.

- *Surface-Water Management System.* The surface-water management system manages surface water under both short-term (i.e., during construction and impacted material placement) and long-term (i.e., after OSDF closure) conditions. The design addresses stormwater runon and runoff, perched ground water, other construction waters, and wastewaters from various sources such as the equipment decontamination facility.

- *Support Elements and Utilities.* Both permanent and temporary support elements are included in the OSDF design. Permanent support elements include survey benchmarks, a perimeter access corridor, and a facility access road. Temporary support elements include construction security fencing, administrative support facilities, equipment decontamination facility, impacted material staging areas, temporary haul roads and construction materials stockpile areas. Utilities include electrical, water, telephone, and wastewater lines for the administrative support areas. The administrative support offices are also provided with parking, security fencing, and all-weather ingress and egress.

LINER AND COVER SYSTEM DESIGN
ON-SITE DISPOSAL FACILTY



NOTE:

1. SELECT IMPACTED MATERIAL THICKNESS ABOVE LINER SYSTEM MAY BE DECREASED TO 2 FEET IF THE FIRST LIFT OF MATERIAL TO BE PLACED OVER THE SELECT IMPACTED MATERIAL CONSISTS OF SOIL OR RELATIVELY SMALL SIZE DEBRIS THAT CAN BE PLACED IN CONTROLLED LIFTS.

GEOSYNTEC CONSULTANTS
ATLANTA, GEORGIA

FIGURE NO.	1-1
PROJECT NO.	GE3900-16.4
DOCUMENT NO.	F9650002.CDO

1.4 CQA Plan Scope

The CQA Plan establishes the quality assurance and quality control procedures and monitoring requirements to be implemented during construction of the OSDF. The CQA Plan was developed to conform the Ohio Environmental Protection Agency (OEPA) requirements (ARAR: OAC 3745-27-08(F)) and relevant U.S. Environmental Protection Agency (USEPA) guidance. The scope of the CQA Plan includes:

- defining the responsibilities of parties involved with the construction of the OSDF;
- providing guidance in the proper construction of liner and cover system components;
- establishing testing protocols for the evaluation of lining and cover system components;
- establishing procedures for construction documentation; and
- providing the means for assuring that the facilities constructed conform to the Applicable or Relevant and Appropriate Requirements (ARARs), specifications, and construction drawings.

The CQA Plan is intended to give guidance to the CQC Consultant and the Subcontractor during the construction of the OSDF and to supplement the specifications of the OSDF Construction Subcontract. This plan is part of the construction subcontract. In the case of any conflicts between the CQA procedures described in this plan and the requirements of the project specifications, the specifications will govern.

It should be noted that the scope of this CQA Plan does not cover procedures for CQA/CQC for placement of impacted materials into the OSDF. CQA/CQC procedures

for placement of impacted materials into the OSDF are contained in the *Impacted Materials Placement Plan*.

1.5 CQA Plan Organization

The remainder of this CQA Plan is organized as follows:

- other OSDF plans related to this CQA Plan are summarized in the remainder of Section 1;
- the requirements from the OSDF DCP applicable to the CQA Plan are presented in Section 2;
- the definitions of key terms are presented in Section 3;
- the project organization and definitions, responsibilities, and qualifications of key parties involved with the construction of the OSDF are presented in Section 4;
- the requirements for CQC documentation are described in Section 5;
- the CQC activities for the soil components of the OSDF lining and final cover systems and general earthwork are presented in Section 6;
- the CQC activities for geomembranes, geosynthetic clay liner, and geotextiles are presented in Sections 7 through 9 respectively;
- the CQC activities for the installation of HDPE manholes, pipes, fittings, and valves are presented in Section 10;

- the CQC activities for appurtenant work items such as mechanical and electrical systems, and concrete appurtenances are described in Sections 11 and 12, respectively;

- the CQC activities for road construction are presented in Section 13; and

- the CQC activities for general site work are presented in Section 14.

1.6 Related Plans

Several other plans have been prepared for the OSDF and contain information relevant to the CQA Plan. These other plans are listed below along with a brief statement of the relationship of the plan to this CQA Plan.

- *OSDF Impacted Materials Placement (IMP) Plan*. The *IMP Plan* contains information regarding the placement, compaction, and testing of impacted materials within the OSDF.

- *OSDF Systems Plan*. The *Systems Plan* contains information regarding the OSDF and various support elements and utilities.

- *OSDF Surface-Water Management and Erosion Control (SWMEC) Plan*. The *SWMEC Plan* addresses stormwater runon and runoff and various aspects of erosion and sediment control.

- *OSDF Borrow Area Management and Restoration (BAMR) Plan*. The *BAMR Plan* addresses the development, operation, and subsequent restoration of the on-site borrow area.

- *OSDF Remedial Action Work Plan*. The plan identifies the implementation strategy and schedule for completion of construction of the OSDF.

2. APPLICABLE REQUIREMENTS

2.1 Overview

Regulatory and other requirements applicable to the CQA Plan are contained in the DCP. These requirements take the form of Applicable or Relevant and Appropriate Requirements (ARARs) for the various FEMP operable units, functional requirements, and general design considerations. The following requirements applicable to the CQA Plan were obtained from the DCP.

2.2 Applicable or Relevant and Appropriate Requirements

Various ARARs provide criteria for the selection and installation of materials to be used in the OSDF liner and final cover systems. Many of the CQA standards described herein were derived from the Ohio Administrative Code (OAC) 3745-27-08. Specific criteria for the OSDF are presented in the following sections.

2.2.1 Liner System

The function of the liner system is to isolate impacted material from the environment while containing and collecting leachate generated by the material. As shown on Figure 1-1, the liner system will contain two liners (i.e., primary and secondary liners), separated by a leak detection system, with the primary liner overlain by a leachate collection system (ARAR: 40 CFR § 265.301(a)). Both the primary and secondary liners will consist of a geomembrane overlying a geosynthetic clay liner; in addition, the components of the secondary liner will be underlain by a 3-ft (0.9-m) thick layer of compacted, low-permeability clay (i.e., a clay with a hydraulic conductivity not more than 1 x 10^{-7} cm/s (ARAR: OAC 3745-27-08(C)(1)(j)(ii)).

2.2.1.1 Compacted Clay Liner

The compacted clay liner shall satisfy the requirements of OAC 3745-27-08(C)(1). Specifically, the compacted clay liner shall be constructed:

- using loose lifts 8 in. thick, or less, to achieve uniform compaction; each lift shall have a maximum hydraulic conductivity of 1 x 10^{-7} cm/s (ARAR: OAC 3745-27-08(C)(1)(a));

- of a soil with a maximum clod size of 3 in., or half the compacted lift thickness, whichever is less (ARAR: OAC 3745-27-08(C)(1)(b)); and

- of a soil with:

  - 100 percent of the particles having a maximum dimension not greater than 2 in.;
  - not more than 10 percent of the particles, by weight, having a dimension greater than 0.75 in.;
  - not less than 50 percent of the particles, by weight, passing through the standard U.S. No. 200-mesh sieve; and
  - not less than 25 percent of the particles, by weight, having a maximum dimension not greater than 0.002 mm (ARAR: OAC 3745-27-08(C)(1)(c)).

As part of the OSDF design, a compacted clay liner test pad program (TPP) was conducted using soil obtained from the area of OSDF excavation. During the TPP, two test pads were constructed using equipment and techniques that are suitable for use in construction of the OSDF clay liner and cap. Laboratory and field permeability testing was performed during the TPP to define the compaction conditions that yield a soil liner or cap with a hydraulic conductivity of not greater than 1 x 10^{-7} cm/s. The TPP was organized to comply with the requirements set forth in OAC 3745-27-08(C)(1)(m).

The results of the TPP, including all laboratory and field hydraulic conductivity test results from the program, are presented in a report entitled *Test Pad Program Final Report*. This report specifies construction equipment types and construction procedures that result in a compacted clay liner satisfying the hydraulic conductivity performance criterion of OAC 3745-27-08(C)(1). The report is available for reference by the Subcontractor and should be consulted for the information contained therein.

During construction of the OSDF liner system, a detailed CQA program must be implemented in accordance with OAC 3745-27-08(F). The CQA activities will include moisture/density testing of soil liner materials at the frequency required by OAC 3745-27-08(C)(1)(o) (i.e., no less than five tests per acre per lift) to verify that the compaction conditions are consistent with those established during the TPP, and monitoring activities in accordance with 40 CFR § 264.303(C). In so doing, a high level of assurance will be provided that the hydraulic conductivity of the soil liner material is not greater than 1×10^{-7} cm/s.

In addition to the foregoing, the compacted clay liner shall:

- be compacted to at least 95 percent of the maximum standard Proctor dry density (ASTM D 698), or at least 90 percent of the maximum modified Proctor dry density (ASTM D 1557) (ARAR: OAC 3745-27-08(C)(1)(d));

- be compacted at a moisture content at or wet of optimum (ARAR: OAC 3745-27-08(C)(1)(e));

- not be comprised of solid waste (ARAR: OAC 3745-27-08(C)(1)(f));

- be constructed using the number of passes and lift thickness, and the same or similar type and weight of compaction equipment, used to obtain acceptable results during the soil liner test pad program (ARAR: OAC 3745-27-08(C)(1)(g));

- be placed on the bottom and excavated exterior slope of the OSDF and have a minimum bottom slope of 2 percent and a maximum slope based on: (i) compaction equipment limitations; (ii) slope stability; (iii) maximum shear strength between soil-geosynthetic and geosynthetic-geosynthetic interfaces; and (iv) resistance of geosynthetics and geosynthetic seams to tensile stresses (ARAR: OAC 3745-27-08(C)(1)(h));

- be constructed on a prepared surface that is: (i) free of debris, foreign material, and deleterious material; (ii) be able to bear the weight of the OSDF without causing or allowing a failure of the compacted clay liner to occur through settling; and (iii) without abrupt changes in grade that could cause damage to the geosynthetics (ARAR: OAC 3745-27-08(C)(1)(i)); and

- be adequately protected from damage due to desiccation, freeze/thaw cycles, wet/dry cycles, and the intrusion of objects during construction, filling, and closure (ARAR: OAC 3745-27-08(C)(1)(l)).

OAC 3745-27-08(D)(1) indicates that the following conformance tests shall be performed on representative samples of the clay to be used for liner construction at a frequency not less than one test per 1,500 yd^3 of soil, except for the hydraulic conductivity testing, which shall be performed at a frequency not less than one test per 10,000 yd^3:

- hydraulic conductivity on specimens compacted to achieve the conditions described in the construction specifications;

- moisture content and dry density using an approved ASTM method;

- grain size distribution using the test method ASTM D 422 for sieve and hydrometer analyses; and

- Atterberg limits using the test method ASTM D 4318.

2.2.1.2 Geosynthetic Clay Liner

The geosynthetic clay liner (GCL) shall satisfy the requirements of OAC 3745-27-08(C)(3). Specifically, the GCL shall:

- be negligibly permeable to fluid migration (interpreted herein to require that the GCL have a maximum a hydraulic conductivity of 5×10^{-9} cm/s);
- be installed having a minimum overlap of 6 in., or, for end of panel seams, a minimum overlap of 12 in. (overlap shall be increased in accordance with manufacturers specifications or to account for shrinkage due to weather conditions);
- have a bentonite mass per unit area of at least one pound per square foot;
- be installed in accordance with the manufacturer's specifications in regard to handling, overlap, and the use of granular or powdered bentonite to enhance bonding at the seams; and
- be constructed above the compacted clay liner.

2.2.1.3 Geomembrane Liner

The geomembrane component of the liner and final cover systems shall satisfy the requirements of OAC 2745-27-08(C)(2). Specifically the geomembrane shall:

- be placed on a GCL which has been previously placed over a compacted clay liner (ARAR: OAC 3745-27-08(C)(2));
- be manufactured of at least 60-mil thick high density polyethylene (ARAR: OAC 3745-27-08(C)(2));

- be protected from the drainage layer by a cushion layer (ARAR: OAC 3745-27-08(C)(2));

- be negligibly permeable to fluid migration (ARAR: OAC 3745-27-08(C)(2)(a));

- be physically and chemically resistant to attack by solid waste, leachate, or other materials which may come in contact with the geomembrane (ARAR: OAC 3745-27-08(C)(2)(b));

- be seamed to allow no more than negligible amounts of leakage; the seaming material shall be physically and chemically resistant to attack by solid waste, leachate, or other materials that may come in contact with the seams (ARAR: OAC 3745-27-08(C)(2)(c));

- have acceptable properties for installation and use (ARAR: OAC 3745-27-08(C)(2)(d)); and

- as necessary, be protected from the overlying leachate collection system by a cushion layer (ARAR: OAC 3745-27-08(C)(2)(e)).

Geomembrane seams shall be tested by the Installer in accordance with the following, unless the geomembrane manufacturer's specifications for testing are more stringent, in which case the manufacturer's specifications shall be used:

- for the purpose of testing every seaming apparatus in use each day, peel and shear tests shall be performed on scrap pieces of geomembrane at the beginning of the seaming period and every 4 hours thereafter (ARAR: OAC 3745-27-08(C)(2)(g)(i));

- nondestructive testing shall be performed on 100 percent of the geomembrane seams (ARAR: OAC 3745-27-08(C)(2)(g)(ii)); and

- destructive testing for peel and shear shall be performed at least once every 500 ft of seam length (ARAR: OAC 3745-27-08(C)(2)(g)(iii)).

2.2.2 Leachate Collection System

The functions of the leachate collection system (LCS) are to collect leachate, route it from the OSDF to the leachate transmission system, and limit the buildup of hydraulic head on the underlying primary composite liner (functional requirements). The LCS shall extend over all areas that will subsequently be used for impacted material disposal and function with minimal maintenance and monitoring.

In accordance with OAC 3745-27-08(D)(2) the following conformance tests shall be performed on representative samples of the granular drainage components of the LCS:

- permeability (ASTM D 2434);
- soil classification (ASTM D 2487);
- particle-size analysis (ASTM C 136); and
- calcium carbonate content (ASTM D 3042).

The conformance tests described above shall be performed at a frequency of not less than one test per 3,000 yd^3 with the exception of calcium carbonate testing which will be performed at a frequency of one test per 5,000 yd^3.

2.2.3 Leak Detection System

The function of the leak detection system (LDS) is to detect leakage through the overlying primary composite liner system. The LDS shall be designed to collect

leakage, should it occur, and route it from the OSDF to the leachate management system. The LDS shall extend over all areas that will subsequently be used for impacted material disposal and as with the LCS, function with minimal maintenance and monitoring.

In accordance with the ARAR OAC 3745-27-08-(D)(2), the following conformance tests shall be performed on representative samples of the granular drainage component of the LDS:

- permeability (ASTM D 2434);
- soil classification (ASTM D 2487);
- particle size analysis (ASTM C 136); and
- calcium carbonate content (ASTM D 3042).

The conformance tests described above shall be performed at a frequency of not less than one test per 3,000 yd^3 with the exception of calcium carbonate testing which will be performed at a frequency of one test per 5,000 yd^3.

2.2.4 Final Cover System

The final cover system must isolate impacted material in the OSDF, protect the OSDF from inadvertent intrusion, promote vegetative growth, and greatly limit infiltration into the facility after closure. The final cover system must also be designed to minimize requirements for long-term monitoring, maintenance, and repair. The components of the final cover system are shown in Figure 1-1 and include (in descending order), topsoil, vegetative soil layer, filter layer, biointrusion barrier, cover drainage layer, composite cap, and impacted-material contouring layer.

2.2.4.1 Topsoil

A vegetated topsoil layer will form the uppermost component of the OSDF final cover system. The topsoil layer shall have healthy grasses or other vegetation that form a complete and dense vegetative cover (ARAR: OAC 3745-27-08(C)(15)(e)). The topsoil shall satisfy the requirements of OAC 3745-27-08-(C)(15)(e).

2.2.4.2 Vegetative Soil Layer

A vegetative soil layer will underlie the topsoil component of the OSDF final cover system. The vegetative soil layer shall satisfy the requirements of OAC 3745-27-08-(C)(15)(e). The vegetative soil layer shall be a well-graded mixture of clayey, silty, and sandy material, at least 1.75 ft thick and have sufficient thickness to protect the geomembrane and compacted clay components of the geocomposite cap from damage due to root penetration (ARAR: OAC 3745-27-08(C)(15)(e)).

2.2.4.3 Granular Filter

A granular filter will underlie the vegetative soil layer component of the OSDF final cover system. The granular filter shall satisfy the requirements of the specifications and comply with the following design criteria:

- be at least 6 in. thick; and
- prevent migration of soil from the vegetative support soil layer through the filter to the biointrusion barrier layer.

2.2.4.4 Biointrusion Barrier

A biointrusion barrier layer shall underlie the granular filter component of the OSDF final cover system. The purpose of this layer is to prevent intrusion of plant roots and burrowing animals into the OSDF. The biointrusion barrier layer shall satisfy the requirements of the specifications and consist of durable cobbles (possibly with gravel and boulder size fractions) at least 3 ft thick and extend at least 40 ft laterally beyond the limit of impacted material disposed in the OSDF.

2.2.4.5 Cover Drainage Layer

A cover drainage layer shall underlie the biointrusion barrier component of the OSDF final cover system and overlie the geomembrane cap component of the OSDF final cover system (OAC 3745-27-08(C)(15)(a)). The cover drainage layer shall consist of a 12 in. thickness of granular drainage material, with the layer meeting the requirements of OAC 3745-27-08(C)(4)(a) (ARAR: OAC 3745-27-08(C)(16)(b)(i)).

2.2.4.6 Geotextile Cushion Layer

A geotextile cushion layer shall satisfy the requirements of the specifications. The geotextile shall be installed above the geomembrane cap component of the OSDF final cover system to protect the geomembrane from puncture by particles in the overlying granular filter layer and resist the effects of construction (i.e., termed construction survivability).

2.2.4.7 Composite Cap

The OSDF final cover system shall contain three low-permeability infiltration barrier layers designed to isolate impacted material from the surrounding environment

while minimizing liquid infiltration into the OSDF. These three layers are, from top to bottom (Figure 1-1):

- 60-mil thick geomembrane cap;
- geosynthetic clay cap; and
- 2-ft thick compacted clay cap.

Taken together, these three layers are called the "composite cap". Applicable criteria for the composite cap are as follows:

- The composite cap shall overlie all areas where impacted material has been placed (ARAR: OAC 3745-27-08(C)(15)).
- The composite cap shall have a permeability less than or equal to the permeability of the liner system (ARAR: 40 CFR §265.310).
- The compacted clay component of the composite cap shall satisfy the requirements of the specifications and have a minimum thickness of 24 in. and a maximum hydraulic conductivity of 1×10^{-7} cm/s (ARAR: OAC 3745-27-08(C)(15)(ii)). In addition, the compacted clay cap must satisfy the requirements of OAC 3745-27-08(C)(1)(a) to (C)(1)(g) and (C)(1)(m) to (C)(1)(o) (ARAR: OAC 3745-27-08(C)(16)(a)(ii)).
- The HDPE geomembrane component of the composite cap shall have a minimum thickness of 60 mils, be negligibly permeable to fluid migration, and satisfy the requirements of OAC 3745-27-08(C)(2) (ARAR: OAC 3745-27-08(C)(16)(a)(ii)).
- The composite cap shall be constructed at a slope between 5 and 25 percent (ARAR: OAC 3745-27-08(C)(15)(f)(ii)).

- Any penetrations through the composite cap system shall be sealed so that the integrity of the compacted clay component of the cap is maintained (ARAR: OAC 3745-27-08(C)(15)).

2.3 Other Considerations

This CQA Plan also reflects the guidance of the Hazardous and Solid Waste Amendments of 1984 to the Resource Conservation and Recovery Act (RCRA), as well as the following Technical Guidance Documents:

- "Construction Quality Assurance for Hazardous Waste Land Disposal Facilities", EPA/530-SW-86- 031, October 1986; and

- "Quality Assurance and Quality Control for Waste Containment Facilities", EPA/600/R-93/182, September 1993.

3. CQA PLAN DEFINITIONS

3.1 Construction Quality Assurance and Construction Quality Control

In the context of this document, construction quality assurance and construction quality control are defined as follows:

- *Construction Quality Assurance (CQA)* - The planned and systematic means and actions designed to assure adequate confidence that materials and/or services meet contractual and regulatory requirements, and will perform satisfactorily in service.

- *Construction Quality Control (CQC)* - Those actions which provide a means to measure and regulate the characteristics of an item or service in relation to contractual and regulatory requirements.

In the context of this document:

- CQA refers to means and actions employed by FDF to assure conformity of the lining and final cover system component production and installation with this CQA plan, the Construction Drawings and Technical Specifications.

- CQC refers to those actions taken by the CQC Consultant, Subcontractor, Manufacturers, or Installers to ensure that the materials and the workmanship meet the requirements of the Construction Drawings and Technical Specifications. In the case of the geosynthetic components of these systems, CQC is provided by the CQC Consultant and the Manufacturers, Fabricators, and Installers of the various geosynthetics.

3.2 Geosynthetics

Geosynthetics is the generic term for all synthetic materials used in geotechnical engineering applications; the term includes geotextiles, geogrids, geonets, geomembranes, geosynthetic clay liners (GCLs) and geocomposites. There are four types of geosynthetic products referenced in this CQA Plan which are included in the OSDF lining and final cover systems. These geosynthetics include (i) textured HDPE geomembranes used in the composite liner and cap; (ii) GCL's used in the composite liner and cap; (iii) geotextiles used as filters or cushions; and (iv) high density polyethylene manholes and pipes used to collect and convey leachate.

3.3 CQA Lines of Communications

The CQA lines of communication between the Construction Manager, Subcontractor, and CQC Consultant are defined in the *OSDF Remedial Action Work Plan*.

4. PROJECT ORGANIZATION AND PERSONNEL

The OSDF construction organization chart is shown in Figure 4-1. Day-to-day construction activities at the OSDF will be managed though the direct interaction of several parties below FDF Project Manager level including but not limited to the Construction Manager, Resident Engineer, Subcontractor, and CQC Consultant. The organization chart for the OSDF CQC Consultant is presented in Figure 4-2. The definitions, qualifications, and responsibilities of the parties responsible for construction and CQC of the OSDF are described below.

4.1 Construction Manager

4.1.1 Definition

The Construction Manager shall be an individual responsible for site operations and overall management of the construction. In this CQA plan the term "Construction Manager" shall refer specifically to an authorized representative of the Department of Energy for the OSDF at the FEMP.

4.1.2 Qualifications

The Construction Manager will hold a baccalaureate degree in construction management, engineering, or related field or have 10 years of construction management experience. The Construction Manager will also have 3 years of environmental restoration plus 1 year of government experience.

4.1.3 Responsibilities

The Construction Manager shall be responsible for coordination and oversight of all construction activities including: (i) subcontract administration; (ii) construction

Figure 4-1

OSDF Construction
Organization Chart

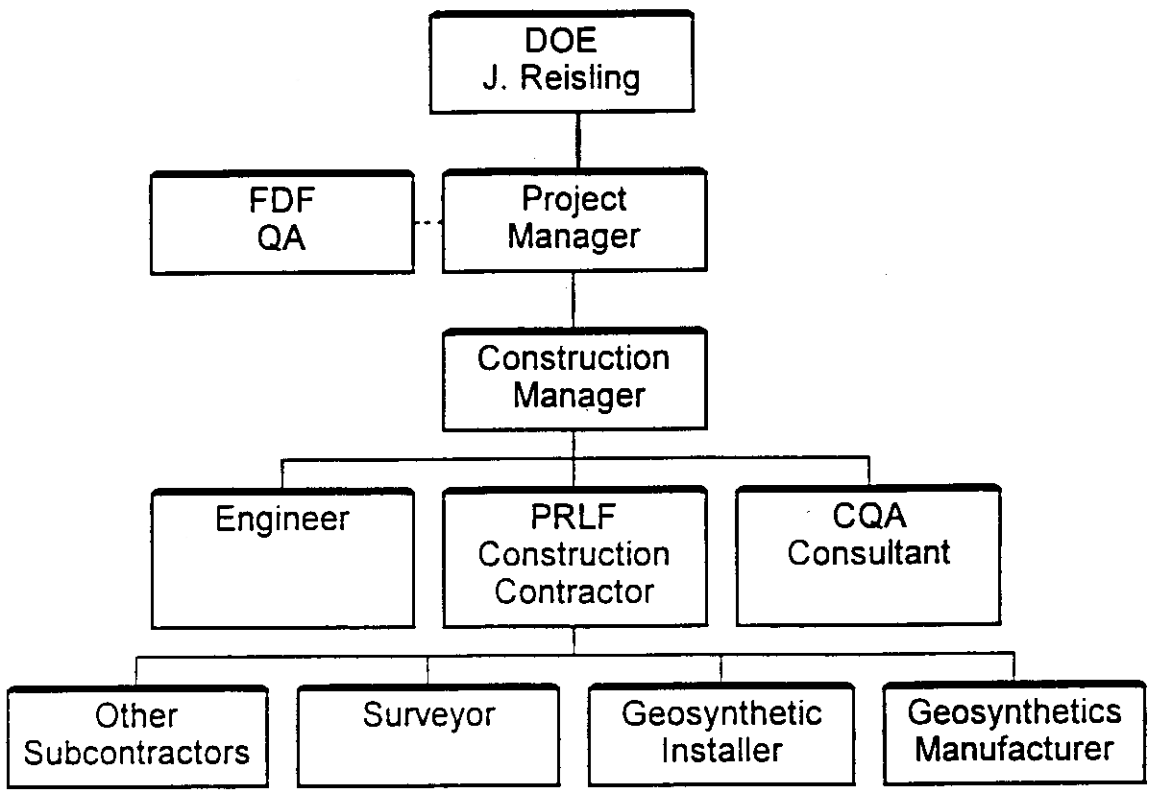
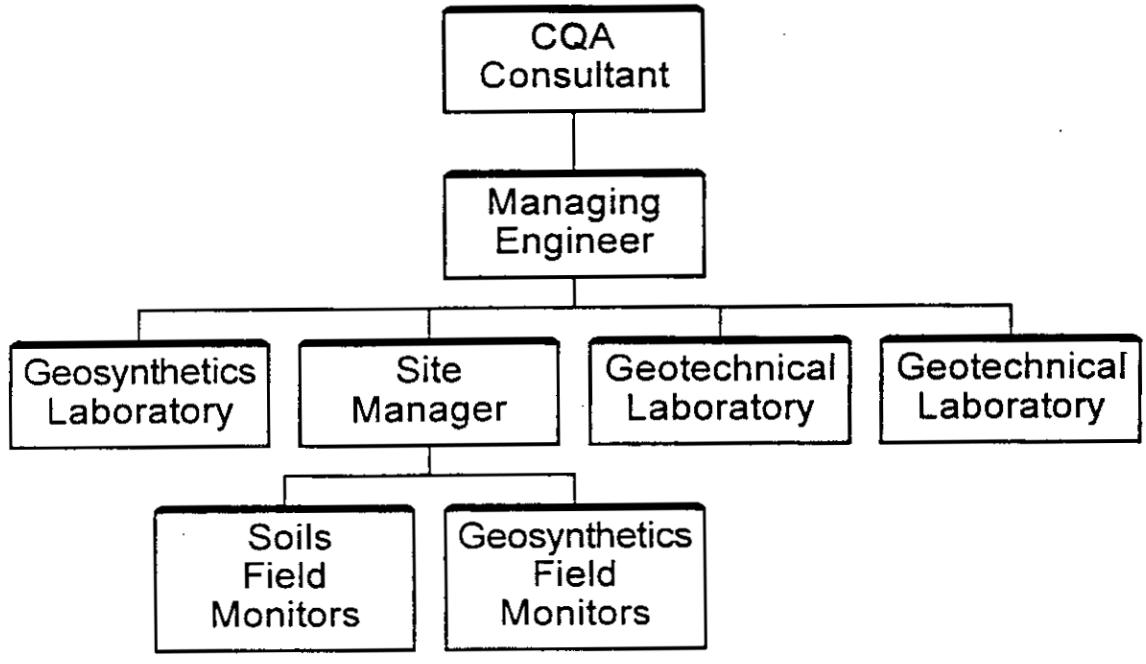


Figure 4-2

OSDF CQA
Organization Chart



management; (iii) review and approval of any modifications or changes to the subcontract documents; and (iv) final approval authority for subcontract submittals.

4.2 Resident Engineer

4.2.1 Definition

The Resident Engineer is the individual representing the firm having responsibility for OSDF design.

4.2.2 Qualifications

The Resident Engineer will hold a minimum of a baccalaureate degree in engineering and be registered as a Professional Engineer and have 10 years experience in construction management, engineering, or related fields. The Resident Engineer shall have expertise which demonstrates significant familiarity with geosynthetics and soils, as appropriate, including design and construction experience related to lining and cover systems.

4.2.3 Responsibilities

The Resident Engineer is responsible for approving all design and specification changes, and making design clarifications which may be required during construction of the OSDF. The Resident Engineer shall assist the Construction Manager in reviewing and approving the Subcontractor's shop drawings and submittals as necessary. The Resident Engineer will be present on-site and attend the project coordination meetings. The Resident Engineer will be capable of discussing and interpreting all elements of the OSDF design. The Resident Engineer shall have the authority to recommend changes or modifications to the Construction Drawings and Technical Specifications for approval by the Construction Manager.

4.3 Subcontractor

4.3.1 Definition

The Subcontractor is the firm or corporation having a legally binding agreement to construct the OSDF. The Subcontractor is represented on-site by a qualified individual who is authorized to act on behalf of the Subcontract in all matters pertaining to the construction of the OSDF.

4.3.2 Qualifications

The Subcontractor shall be qualified as required by the subcontract to perform all aspects of work required to successfully construct the project. The Subcontractor shall be registered in accordance with applicable local, state, and federal requirements and shall demonstrate significant prior related experience. The Subcontractor's field representative shall be qualified individual who is able to perform all tasks associated with OSDF construction activities. The Subcontractor's field representative shall demonstrate prior and experience similar to the Construction Manager. The Subcontractor's field representative shall have the authority to direct and instruct the Subcontractor's crews and its lower tier Subcontractors.

4.3.3 Responsibilities

The Subcontractor is responsible for all construction materials and activities. The Subcontractor is also responsible for scheduling and coordination of the required work with its lower-tier Subcontractors to complete the project within the construction schedule approved by the Construction Manager. The Subcontractor shall provide an experienced supervisory representative at all times during any construction activity on site. The Subcontractor is responsible for furnishing as-built record drawings and a copy of all documentation required during the construction of the OSDF. The

Subcontractor is also responsible for updating all construction drawings for any deviations from the original plans and specifications on a daily basis.

The Subcontractor's field representative is responsible for coordinating and supervising the work of all Subcontractors on site. At a minimum, the Subcontractor's field representative will be responsible for the following:

- informing the Construction Manager of any discrepancies between the plans and specifications and the field conditions;
- distributing all documentation required by the Construction Drawings and Technical Specifications in a timely manner;
- attending all project coordination meetings held on site;
- scheduling all phases of the construction;
- maintaining a daily log of all construction activities on site;
- implementing and verifying all QC procedures required of the Subcontractor and/or lower-tier Subcontractors: and
- submitting proposed alternative materials or construction methods to the Construction Manager for approval prior to acquisition and use.

4.4 CQC Consultant

4.4.1 Definition

The CQC Consultant is the party, independent from the Construction Manager and the Subcontractor, responsible for observing, testing, and documenting activities related

to the CQC of the soil and geosynthetic components of the OSDF lining and final cover systems and other activities related to the construction and closure of the OSDF.

4.4.2 Qualifications

The CQC Consultant shall be a well-established firm specializing in liner and final cover system design, construction management, and CQC. The CQC Consultant shall possess the equipment, personnel, and licenses necessary to conduct the monitoring and testing activities required by the OSDF Construction Drawings and Technical Specifications. The CQC Consultant shall also be experienced in the installation and CQC of soil and geosynthetic materials similar to those materials to be used for the lining and final cover system. The CQC Consultant will be experienced in the preparation of CQC documentation including CQC plans, field documentation, field testing procedures, laboratory testing procedures, construction specifications for lining and cover systems, construction plans, and certification reports. The CQC Consultant shall provide qualified staff for the project.

In addition, the CQC Consultant shall provide the following, in writing, to the Construction Manager:

- corporate background and information;
- a detailed summary of the firm's CQC capabilities;
- a detailed summary of the firm's CQC experience; and
- a representative list of at least 10 completed facilities for which the CQC Consultant has provided CQC monitoring services for the installation of the corresponding geosynthetic material; for each facility, the following information will be provided:
  - name and purpose of facility, its location, and date of installation;
  - name of owner;

- surface area of each geosynthetic material installed; and
- telephone number of person familiar with the project.

- résumés of CQC personnel to be involved in the project including the CQC, Managing Engineer, CQC Site Manager, and CQC Field Monitors; and

- proof of Professional Engineering registration (or ability to be registered) for the engineer to be the designated CQC Managing Engineer.

The CQC Consultant's personnel shall include:

- the CQC Managing Engineer, who operates from the office of the CQC Consultant and who conducts periodic visits to the site as required;

- the CQC Site Manager, who is located at the site; and

- the CQC Field Monitors, who will be located at the site.

The CQC Consultant organization will be led by the CQC Managing Engineer, who will hold a baccalaureate degree in engineering and be registered as a Professional Engineer. The CQA Site Manager will be the representative of the CQC Consultant on site and will have a minimum of 10 years experience in similar construction and be specifically familiar with the construction of soil and geosynthetic liner and closure system components.

At a minimum, the lead geosynthetics Field Monitor shall have performed CQC activities for the installation of at least 5,000,000 ft^2 of HDPE geomembrane and hold current certification by the National Institute for the Certification of Engineering Technicians (NICET) for the Installation Inspection of Geosynthetic Materials. The lead soils Field Monitor shall have performed CQC activities for the installation of at least 2,500,000 ft^2 of low-permeability clay liner and cover systems. Other Field Monitors will be personnel who are specifically trained in the CQC of geosynthetics and low permeability clays and have documented CQC monitoring experience.

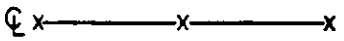
SYMBOLS

S11/P12 — SECONDARY/PRIMARY GEOMEMBRANE PANEL NUMBER

NDT = NONDESTRUCTIVE TEST

VT = VACUUM TEST

AT = AIR TEST



LEACHATE COLLECTION PIPE

TOE OF SLOPE

CREST OF SLOPE

ANCHOR TRENCH

EXTRUSION WELD

GEOGRID

GEONET

GEOTEXTILE

GEOCOMPOSITE LAYER

CAPPED SEAM (FUSION)

NDT TESTED

DESTRUCTIVE SAMPLE (DS) LOCATION
P=PRIMARY
S=SECONDARY

(FAILED)

(PASSED)

NDT TESTED

EXTRUSION WELD REPAIR

NDT TESTED

COUPON SAMPLE LOCATION

NDT TESTED

PATCH REPAIR LOCATION (EXTRUSION)

NDT TESTED

PIPE PENETRATION

SUMP AREA

60

THICKNESS MEASUREMENT

ADJACENT PANEL REFERENCE

The CQC Consultant shall establish an on-site soils laboratory having qualifications as specified in Section 4.5.2 of this CQA Plan.

4.4.3 Responsibilities

The CQC Consultant shall be responsible for monitoring and documenting the activities of the Subcontractor relative to the installation of the liner and cover system components as well as various appurtenances related to the construction of the OSDF. The CQC Consultant will be responsible for monitoring the compliance of construction materials delivered to the site with the submittals and/or shop drawings previously reviewed by the Construction Manager. The CQC Consultant shall assure that the Subcontractors construction methods and workmanship are performed in accordance with the Construction Drawings and Technical Specifications. The CQC Consultant shall be responsible for obtaining samples of the various construction materials in accordance with the testing frequencies identified in this plan. The CQC Consultant shall also be responsible for obtaining, labeling, and shipping samples for off-site laboratory testing in accordance with the requirements of this plan and appropriate specifications.

The CQC Consultant shall be responsible for soils quality control testing to be performed by both the on-site and off-site testing laboratories. The CQC Consultant shall be responsible for operating and staffing the on-site soils laboratory. Test results from the on-site and off-site laboratories shall be submitted to the Construction Manager within a time frame which will not impede or delay construction activities.

The on-site soils laboratory shall be equipped to perform routine index testing including:

- standard or modified Proctor (ASTM D 698 or D 1557);
- particle-size analysis (ASTM D 422 and ASTM C 136);

GeoSyntec Consultants

FLUOR DANIEL FERNALD

DESTRUCTIVE TEST LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: ______

DESCRIPTION: ______ YEAR: ______

CONTRACTOR: ______ TEST REQUIREMENTS: ______

PRIMARY: ☐ SECONDARY: ☐ RE-TEST: ☐ OTHER: ☐ ______

DISTRIBUTION: LABORATORY: ☐ ARCHIVE: ☐ INSTALLER: ☐ OTHER: ☐

SAMPLE DATA					FIELD DATA					LABORATORY DATA						
D.S. NO.	SEAM/ LOCATION	MACH NO.	OPER ID	DATE SAMPLED/ SHIPPED (day/mo)	AVG PEEL (PPI/PSI)		AVG SHEAR (PPI/PSI)	PASS/ FAIL	QA ID	DATE OF RESULTS (day/mo)	AVG PEEL (PPI/PSI)		AVG SHEAR (PPI/PSI)	PASS/ FAIL	RE-TEST	QA ID
					INSIDE	OUTSIDE					INSIDE	OUTSIDE				
(15)																

- Atterberg limits (ASTM D 4318);
- moisture content (ASTM D 2216 and ASTM D 4643);
- soils classification (ASTM D 2487); and
- percent passing no. 200 sieve (ASTM D 1140).

The CQC Consultant shall also be responsible for conducting routine field tests during construction of the OSDF liner and final cover systems which shall include:

- surface moisture content (ASTM D 3017);
- in-place density by nuclear methods (ASTM D 2922);
- lift thickness by direct measurement; and
- sand cone (ASTM D 1556).

The CQC Consultant will be responsible for the quality control of its on-site laboratory testing program and for documenting the calibration of the soils laboratory testing equipment. Equipment calibration certificates shall be maintained in the CQC Consultant's on-site project file. All tests will be conducted in accordance with ASTM or other applicable state or federal standards. Test results shall be submitted to the Construction Manager within a time frame which will not impede or delay construction of the liner and cover systems.

The duties of the CQC Personnel are discussed in the following subsections.

4.4.3.1 CQC Managing Engineer

The CQC Managing Engineer:

- reviews the liner and cover systems construction plans and Construction Drawings and Technical Specifications;
- reviews liner and cover system soils and geosynthetics-related documents (such reviews are for familiarization and for evaluation of constructibility only);
- attends project meetings related to construction quality activities;
- administers the CQC program (i.e., assigns and manages all on-site CQC personnel, reviews all field reports, and provides engineering review of all CQC related activities);
- provides quality control of CQC documentation;
- reviews changes to the liner and cover system design, Construction Drawings, and Technical Specifications; and
- with the CQC Site Manager, prepares the final report.

4.4.3.2 CQC Site Manager

The CQC Site Manager:

- acts as the on-site representative of the CQC Consultant;
- familiarizes all CQC Field Monitors with the site, project documents, and the CQC requirements;

- manages the daily activities of the CQC Field Monitors;
- attends regularly-scheduled CQC-related meetings on-site;
- reviews the ongoing preparation of the construction record drawings;
- reviews test results provided by the Subcontractor;
- verifies the calibration and condition of on-site testing equipment;
- reviews the CQC Field Monitors' daily reports and logs;
- reports to the Construction Manager, and documents in a daily report any reported relevant observations by the CQC Field Monitors;
- prepares a daily report for the project;
- oversees the collection and shipping of all laboratory test samples;
- reviews results of laboratory testing and makes appropriate recommendations;
- reports any unresolved deviations from the CQA Plan, construction plans, and Construction Drawings and Technical Specifications to the Construction Manager;
- assists with the preparation of the final report;
- reviews appropriate certifications and documentation from the Subcontractor and the Geosynthetics Manufacturer and Installer, and makes appropriate recommendations;
- reviews the Geosynthetics Manufacturer's QC documentation;

- reviews the Geosynthetics Installer's personnel qualifications for conformance with those pre-approved for work on site; and

- performs duties of CQC Field Monitor as needed.

4.4.3.3 CQC Field Monitors

The duties of the CQC Field Monitors are monitoring and documenting construction of all soils and geosynthetics components of the liner and cover systems and other OSDF appurtenances, as assigned by the CQC Site Manager.

The duties of the Field Monitors may include:

- monitoring material stockpiles for any deterioration of materials;

- monitoring surface-water drainage in the areas of soil and geosynthetic material stockpiles;

- preparing daily field reports;

- recording CQC activities on field logs;

- reporting problems to the CQC Site Manager;

- assisting with collection of samples from the constructed soil components in accordance with the CQA Plan;

- monitoring soil placement and compaction operations;

- monitoring the unloading and on-site handling and storage of the geosynthetics;

- monitoring geosynthetic repair operations;
- monitoring geosynthetic material deployment and installation operations; and
- collecting conformance samples for testing by CQA laboratories.

In addition to these specific duties, all CQC Field Monitors will document any on-site activities that could result in damage to the soils or geosynthetic components of the liner and cover systems. This is particularly true during the placement and compaction of the initial lift of soil on top of the underlying geosynthetic material. Any observations so noted by the CQC Field Monitors shall be reported immediately to the CQC Site Manager.

4.5 Soils CQC Laboratory

4.5.1 Definition

The Soils CQC Laboratory is the party, independent from the Construction Manager and Subcontractor, responsible for conducting geotechnical laboratory tests in accordance with standards referenced in the Construction Drawings and Technical Specifications and this CQA Plan. The testing results generated by the Soils CQC Laboratory shall be used by the CQC Consultant to verify compliance of the soils construction materials with the plans and specifications and submittals previously approved by the Construction Manager.

It is anticipated that the Soils CQC Laboratory will be required to perform the conformance evaluation testing of the various soils components of the OSDF and more sensitive performance testing required during construction such as hydraulic conductivity testing which require tightly controlled laboratory conditions.

4.5.2 Qualifications

The Soils CQC Laboratory will be experienced in testing of soils similar to those proposed for use in the construction of the OSDF in accordance with ASTM and other applicable soil test standards. The Soils CQC Laboratory will be capable of providing test results within a maximum of 7 days of receipt of samples and will maintain that capability throughout the duration of the earthwork construction.

Prior to construction, the Soils CQC Laboratory, if different from the CQC Consultant, shall submit their qualifications and QA/QC procedures to the Construction Manager for review and approval. The qualifications presented by the Soils CQC Laboratory shall, as a minimum, include:

- corporate background and statement of qualifications;
- list of testing capabilities including reference to ASTM test methods;
- a laboratory QA/QC plan:
- information on staff size and experience; and
- information regarding test result turnaround time.

4.5.3 Responsibilities

The Soils CQC Laboratory will be responsible for testing various soils components of the OSDF liner and final cover systems. These tests shall include, but not be limited to, material qualification (conformance) tests and material construction quality control (performance) tests as described in Construction Drawings and Technical Specifications. The CQC Consultant will be responsible for coordinating the Soils CQC Laboratory testing.

4.6 Geosynthetics CQC Laboratory

4.6.1 Definition

The Geosynthetics CQC Laboratory is the party, independent from the Construction Manager, Subcontractor, and Geosynthetics Manufacturer and Installer, responsible for conducting tests on samples of geosynthetic materials used in construction of the OSDF liner and cover systems in accordance with standards referenced in the Construction Drawings and Technical Specifications and this CQA Plan. The testing results generated by the Geosynthetics CQC Laboratory shall be used by the CQC Consultant to verify compliance of the geosynthetic materials with plans and specifications and submittals previously approved by the Construction Manager.

It is anticipated that the Geosynthetics CQC Laboratory will be required to perform the conformance evaluation testing of the various geosynthetic components of the OSDF and the performance testing required during construction such as destructive seam testing.

4.6.2 Qualifications

The Geosynthetics CQC Laboratory shall hold current accreditation by Geosynthetic Research Institute (GRI) and have experience in testing geosynthetics similar to those proposed for use during construction of the OSDF. The Geosynthetics CQC Laboratory shall be familiar with ASTM and other applicable geosynthetic test standards. The Geosynthetics CQC Laboratory will be capable of providing destructive test results for geomembrane field seams within 24 hours of receipt of samples and will maintain that capability throughout the duration of geosynthetic material installation.

Prior to construction, the Geosynthetics CQC Laboratory, if different from the CQC Consultant, shall submit their qualifications to the Construction Manager for review and approval. The qualifications presented by the Geosynthetics CQC Laboratory shall, as a minimum, include:

- corporate background and statement of qualifications;
- listing of testing capabilities including reference to ASTM or other applicable test methods;
- a laboratory QA/QC plan:
- information on staff size and experience; and
- information regarding test result turnaround time.

4.6.3 Responsibilities

The Geosynthetics CQC Laboratory will be responsible for testing various geosynthetic components of the liner and cover systems. These tests shall include, but not be limited to, geosynthetic conformance tests and destructive testing of the geomembrane field seams as described in the Construction Drawings and Technical Specifications. The CQC Consultant will be responsible for coordinating the Geosynthetics CQC Laboratory testing.

4.7 Geosynthetics Manufacturers

4.7.1 Definition

The Geosynthetics Manufacturers are the firms or corporations responsible for production of the geosynthetic materials to be used in construction of the OSDF.

4.7.2 Qualifications

The Geosynthetics Manufacturers shall be able to provide sufficient production capacity and qualified personnel to meet the demands of the project schedule. Prior to shipment of any material to the site, each Geosynthetics Manufacturer shall be pre-qualified and approved by the Construction Manager. The geotextile, geomembrane, and GCL manufacturers shall meet the qualifications outlined in Sections 02714, 02770, and 02772 of the Technical Specifications, respectively.

4.7.3 Responsibilities

Each Geosynthetics Manufacturer is responsible for the production and quality control of its respective geosynthetic product. In addition each Geosynthetics Manufacturer is responsible for the condition of the geosynthetic until the material is accepted by the Subcontractor. Each Geosynthetics Manufacturer shall produce a consistent high quality product which shall meet all the requirements of the specifications. Each Geosynthetics Manufacturer shall submit quality control documentation to the Construction Manager for its respective products as required by the Technical Specifications.

4.8 Geosynthetics Installer

4.8.1 Definition

The Geosynthetics Installer will be experienced and qualified to install the geosynthetic materials of the type specified for this project. The Geosynthetics Installer will be approved and/or licensed by the Geosynthetics Manufacturer. A copy of the approval letter or license will be submitted by the Subcontractor to the Construction Manager as required by the Technical Specifications.

4.8.2 Qualifications

The Geosynthetics Installer shall meet the qualifications outlined in Section 02770 of the Technical Specifications.

The Geosynthetics Installer will designate one representative as its supervisor, who will be responsible for acting as the Geosynthetics Installer's spokesman on site. The Geosynthetics Installer will provide the Construction Manager with a list of proposed seaming personnel and their qualifications. This document will be reviewed by the CQC Consultant. Final approval of the Geosynthetic Installers seaming personnel will be the responsibility of the Construction Manager. Any proposed seaming personnel deemed insufficiently experienced will not be accepted. The most experienced seamer, the "master seamer", shall provide direct supervision, as required, over less experienced seamers. No field seaming shall take place without the master seamer being present.

4.8.3 Responsibilities

The Geosynthetics Installer's supervisor will be responsible for handling installation of the geosynthetics used in construction of the OSDF and for providing supervision and guidance to the installation crew. The Geosynthetics Installer's supervisor is also responsible for the following: (i) obtaining samples, as required by the CQA Plan and the specifications; (ii) field testing; (iii) documenting quality control testing activities; and (iv) coordinating the geosynthetics installation activities with the Construction Manager. The Geosynthetics Installer's supervisor will be responsible for documenting the geosynthetics installation activities, including, but not limited to, on-site personnel, material inventories, production figures, test results, installation deficiencies, and resolution of construction problems.

4.9 Surveyor

4.9.1 Definition

The Surveyor is responsible for lines and grades required for control of the work on an ongoing basis during all phases of the OSDF construction. Close interaction between the Surveyor, Subcontractor, and the CQC Consultant is essential to ensure that construction of the OSDF is completed in accordance with the Construction Drawings and Technical Specifications.

4.9.2 Qualifications

The project Surveyor shall be a licensed Professional Land Surveyor who shall sign and seal all construction survey record drawings. All surveying personnel shall be experienced in the provision of surveying services, including detailed accurate documentation as required in Section 02100 of the Technical Specifications.

4.9.3 Responsibilities

The Surveyor is responsible for all surveying activities and products in accordance with Section 02100 of the Technical Specifications.

5. DOCUMENTATION

An effective CQA Plan depends largely on recognition of all construction activities that should be monitored and the assignment of responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of quality assurance and quality control activities. The CQC Consultant shall be responsible for assuring that the Subcontractor's quality control requirements have been addressed and satisfied.

The CQC Site Manager shall make available to the Construction Manager descriptive daily field reports, data sheets, and logs which document that monitoring activities have been carried out. The CQC Site Manager will submit weekly reports to the Construction Manager covering significant activities and observations during the preceding week. Examples of some of the forms which will be used to document CQC activities are included in Appendix A. The CQC Site Manager shall also maintain at the job site a complete file of Construction Drawings and Technical Specifications, this CQA Plan, the Subcontractor's Quality Control Plan(s), checklists, test procedures, daily logs, and other pertinent construction and CQC documents.

5.1 Daily Recordkeeping

The CQC Consultant's daily reporting procedures shall include: (i) daily summary report; (ii) monitoring logs; (iii) testing data sheets; and (iv) when appropriate, problem identification and corrective measures reports.

5.1.1 Daily Summary Reports

The CQC Consultant's daily summary reports shall include the following information as applicable:

- an identifying sheet number for cross referencing and document control;
- date, project name, location, and other pertinent project identification;
- data on weather conditions;
- summary on meetings held and their results;
- process description(s) and location(s) of construction underway during the time frame of report;
- descriptions and specific locations of areas, or units, of work being tested and/or observed and documented;
- description of locations where tests and samples were taken;
- a narrative summary of field test results;
- off-site materials received, including quality control documentation;
- decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard testing results;
- identifying sheet numbers of data sheets and/or problem reporting and corrective measures reports used to substantiate the decisions described above;
- signature of the respective CQC Site Manager and/or the CQC Field Monitor; and
- any corrections to the Daily Summary Reports shall be single line crossed out, initialed by the correcting personnel, and dated.

5.1.2 CQA Monitoring Logs and Test Data Sheets

Monitoring observations, sampling information, and test results shall be recorded on an appropriate monitoring logs and test data sheets. The CQC Consultant shall use the monitoring logs and test data sheets to ensure completeness of the required CQC activities. Any corrections to the monitoring logs and test data sheets shall be single line crossed out, initialed by the CQC personnel responsible for the correction and dated. Examples of relevant monitoring logs are presented in Appendix A.

The CQC Consultant's monitoring logs and test data sheets shall include the following information as applicable:

- project specific information such as project name, location;
- the date the CQC activity was performed;
- a unique identifying sheet number for cross-referencing and document control;
- description or title of the CQC activity or test procedure;
- location of the CQC activity or location from which the sample increment was obtained;
- type of CQC activity or procedure used (reference to standard method when appropriate);
- recorded observation or test data, with all necessary calculations;
- results of the CQC activity and comparison with specification requirements (pass/fail); and
- the initials or signature of personnel involved in CQC inspection activity.

5.1.3 Nonconformance Identification and Reporting

A nonconformance is defined herein as material or workmanship that does not meet the specified requirement(s). Nonconformance identification and corrective measures reports should be cross-referenced to specific summary reports, logs, or test data sheets where the nonconformance was identified. The reports should include the following information as applicable:

- a unique identifying sheet number for cross-referencing and document control;
- detailed description of the problem;
- location of the problem;
- probable cause;
- how and when the problem was located;
- estimation of how long problem has existed;
- suggested corrective measure;
- documentation of correction (reference to inspection data sheets);
- final results;
- suggested methods to prevent similar problems; and
- signature of the appropriate CQC Field Monitor and concurrence by the CQC Site Manager.

In some cases, not all of the above information will be available or obtainable. However, when available, such efforts to document nonconformances could help to

avoid similar nonconformances in the future. The CQC Site Manager shall distribute copies of the report to the Construction Manager for further actions.

5.2 Photographic Documentation

The Construction Manager will be responsible for obtaining photographic documentation of the Subcontractor's activities, materials installation methods, and testing procedures. Photographs will serve as a pictorial record of work progress, problems, and corrective measures. Photographic reporting data sheets should be utilized to organize and document photographs taken during construction of the OSDF also may prove useful. Such data sheets could be cross-referenced or appended to summary reports, CQC monitoring logs, or test data sheets and/or problem identification and corrective measures reports. At a minimum, photographic reporting data sheets should include the following information:

- a unique identifying number on data sheets and photographs for cross-referencing and document control;
- the date and location where the photograph was taken; and
- location and description of the work;

These photographs will serve as a pictorial record of work progress, problems, and corrective measures. Color prints shall be organized chronologically and kept in a permanent protective file. Negatives shall be stored in a separate protective file.

5.3 Design and/or Specifications Changes

Design and/or specifications changes may be required during construction. In such cases, the Subcontractor must submit written requests for such changes to the Construction Manager. The Resident Engineer shall review and respond to these requests in a timely manner. Design and/or specifications changes will be made only

with the approval of the Construction Manager. Such changes will take the form of a design change notice (DCN) to the Subcontract.

5.4 Nonconformances

The Construction Manager will be informed in writing of any significant recurring nonconformance with the Construction Drawings, Technical Specifications, or CQA Plan by the CQC Consultant. The cause of the nonconformance will be determined by the CQC Consultant. The Subcontractor will be directed by the Construction Manager to make appropriate changes in materials or procedures in order to correct the nonconformance. When this type of evaluation is made, the results will be documented, and any revision to procedures or specifications must be approved by the Construction Manager.

5.5 CQC Certification Report

At the completion of construction phases the CQC Consultant will submit a construction phase final report to the Construction Manager. This report will acknowledge: (i) that the work has been performed in compliance with the Construction Drawings and Technical Specifications; (ii) physical sampling and testing has been conducted at the appropriate frequencies; and (iii) that the summary document provides the necessary supporting information.

At a minimum, this report will include:

- summaries of CQC activities;
- CQC monitoring logs and testing data sheets including sample location plans;
- laboratory test results;
- problem identification and corrective measures reports;

- a descriptive summary of any changes from Construction Drawings and Technical Specifications; and

- a summary statement indicating compliance with Construction Drawings and Technical Specifications which is signed and sealed by the CQC Managing Engineer.

The Subcontractor's record drawings, which include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, etc.), and a geomembrane panel record drawings prepared by the CQC Consultant and included as part of the final certification report.

5.6 Storage of Records

The CQC Site Manager will be responsible for all facility CQC document storage during the construction of the OSDF. This includes the CQC Consultant's copy of the Construction Drawings and Technical Specifications, the CQA Plan, and the originals of all the data sheets and reports. When the OSDF construction is complete and upon issuance of the final certification report, the CQC document originals will be organized and submitted to the Construction Manager. Records shall be filed in accordance with the subject file index and shall be retained for 30 years after closure of the OSDF. Required records shall include, but not be limited to, field logbooks, other data collections forms, equipment calibration records, costs data, drawings, maintenance records, and all associated reports.

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6. SOILS CONSTRUCTION

6.1 Introduction

CQC monitoring and testing shall be performed during installation of the various soil liner and cover system and other earthwork components. Criteria to be used for determination of acceptability of the various soil layers are identified in the Construction Drawings and Technical Specifications and this CQA Plan.

6.2 Soil Components

There are several soil components included in OSDF liner and cover systems. The soil components or layers of the OSDF liner system include the following, from top to bottom:

- a 1-ft thick granular LCS layer and corridor having a hydraulic conductivity of 1 x 10^{-1} cm/s or greater and 10 cm/s respectively;
- a 1-ft thick granular LDS layer and corridor having a hydraulic conductivity of 1 x 10^{-1} cm/s or greater and 10 cm/s respectively; and
- a 3-ft thick compacted clay layer having a hydraulic conductivity of 1 x 10^{-7} cm/s or less.

The soil layers of the OSDF final cover system include the following, from top to bottom:

- a 0.5-ft thick topsoil layer;
- a 1.75-ft thick vegetative soil layer;

- a 0.5-ft thick granular filter layer;
- a 3-ft thick biointrusion barrier;
- a 1-ft thick cover drainage layer having a hydraulic conductivity of 1×10^{-1} cm/s or greater; and
- a 2-ft thick compacted clay cap having a hydraulic conductivity of 1×10^{-7} cm/s or less.

The prepared subgrade soils which will support the OSDF liner system will require preparation in the form of grading, placement, and compaction prior to the installation of the liner system materials. The prepared soil subgrade layer will generally be comprised of in situ materials or borrow area fill materials which must also be monitored and tested in accordance with the Construction Drawings and Technical Specifications and this CQA Plan.

Trench backfilling and the miscellaneous soil construction is also included in this section of the CQA Plan.

6.3 Record Drawings and As-Built Surveys

During construction of the soil components of OSDF, the CQC Consultant shall routinely review record drawings submitted by the Subcontractor. The drawings are used to verify location of work, percent of work completed, layer thickness, or final grades. Prior to the placement of successive soil or geosynthetic layers the CQC Consultant shall review certified as-built surveys which indicate compliance of the preceding layer thickness, lines, and grades. Once an as-built survey has been reviewed by the CQC Consultant it will be the responsibility of the Construction Manager to review the information in a timely manner and notify the Subcontractor of any noncompliance.

6.4 Related Construction Drawings and Technical Specifications

Several sections of the Technical Specifications should be referenced by the CQC Consultant for pertinent soil materials physical properties and construction requirements. Related specifications include the following:

- Section 02100 - Surveying;
- Section 02200 - Earthwork;
- Section 02215 - Trenching and Backfilling;
- Section 02225 - Compacted Clay Liner and Cap;
- Section 02250 - Vegetative Soil Layer;
- Section 02710 - Granular Drainage Layer;
- Section 02712 - Granular Filter; and
- Section 02920 - Topsoil.

6.5 Earthwork

Prior to the start of earthwork operations, the CQC Consultant shall review the information required by Section 02200 of the Technical Specifications. Compliance of the submittals with the Technical Specifications shall be determined by the Construction Manager.

During construction, conformance and performance testing of the subgrade soil materials shall be performed by the CQC Consultant. The CQC Consultant shall monitor proofrolling of areas that are cut to achieve grade. Material placed to achieve

grades indicated on the Construction Drawings shall be tested by the CQC Consultant in accordance with the tests methods and frequencies shown in Table 6-1 and 6-3, to verify that the compacted fill material used by the Subcontractor complies with the Technical Specifications. Areas of proofrolling or compacted fill that do not meet the Technical Specifications will be delineated and reported to the Construction Manager. The areas will be retested after any reworking by the Subcontractor. This process will be repeated until passing results are achieved.

The CQC Consultant shall monitor the repair and rework of subgrade which is damaged by excess moisture (causing softening) and insufficient moisture (causing desiccation and shrinkage), or by freezing. If such conditions are found to exist, the CQC Consultant shall evaluate the suitability of the subgrade by the following methods as applicable:

- moisture/density testing;
- continuous visual inspection during proof-rolling;
- checking the consistency of cohesive soils using a penetrometer, hand-held vane shear device, or other suitable field expedient measurement device in suspect weak soil areas; and/or
- other tests identified in Tables 6-1 through 6-4.

6.6 Conformance Testing

It will be necessary for the CQC Consultant to observe and test the soil components of the OSDF liner and cover systems to ensure they are uniform and conform to the requirements of the Technical Specifications. For soil materials obtained from the on-site borrow area, visual inspections and conformance tests shall be performed by the CQC Consultant prior to the materials being excavated. If soil materials are obtained from off site borrow sources, visual inspection and conformance

tests shall be performed at the source location or as the materials arrive at the OSDF site. Borrow area inspections may also be utilized by the CQC Consultant to ensure that only suitable soil materials are transported to the OSDF site. For both on-site and off-site borrow areas containing non-uniform materials, it shall be necessary for the Subcontractor and the CQC personnel to coordinate excavation and monitoring of the segregation of substandard materials. All materials failing to comply with conformance standards shall be reported to the Construction Manager.

Initial evaluation of various soil types by CQC personnel during construction shall be largely visual; therefore, the CQC personnel must be experienced with visual-manual soil classification procedures. CQC personnel shall be aware that changes in color or texture can be indicative of a change in soil type. CQC personnel shall observe soils for deleterious materials (e.g., roots, stumps, glass, and large objects). When necessary, the visual-manual procedure for the description and identification of soils shall be conducted by the CQC Consultant in accordance with test method ASTM D 2488.

6.6.1 Test Methods

Conformance tests used to evaluate the suitability of soil materials during construction shall be performed in accordance with the current ASTM or other applicable test procedures indicated in Tables 6-1 and 6-2. Documentation and reporting of the test results shall be the responsibility of the CQC Consultant.

The Standard Proctor Test (ASTM D 698) shall be used for the determination of moisture/density relationships unless otherwise indicated. In-place surface moisture/density nuclear test methods (ASTM D 3017 and D 2922) shall be used for in-situ field testing. The sand cone test method (ASTM D 1556) shall be used to establish correlations of moisture and density in cases of uncertainty, and as a check of the nuclear surface moisture/density gauge calibration. Any conflict regarding acceptance of test results shall be resolved by the Construction Manager.

6.6.2 Test Frequency

The frequency of conformance tests shall conform to the minimum frequencies presented in Tables 6-1 and 6-2. The frequency of testing may be increased at the discretion of the Construction Manager or if variability of the materials is observed. The testing frequencies described herein for compacted fill shall also apply to materials used by the Subcontractor in areas outside the limits of the final cover system of the OSDF.

6.7 Construction Monitoring

During installation of the various soil components, the CQC Consultant shall visually observe and document the Subcontractor's earthwork activities for the following:

- changes in the soil consistency;
- the thickness of lifts as loosely placed and as compacted;
- soil liner conditioning prior to placement including general observations regarding moisture distribution, clod size, etc.;
- the action of the compaction and heavy hauling equipment on the construction surface (sheepsfoot penetration, pumping, cracking, etc.);
- the number of passes used to compact each lift;
- desiccation cracks or the presence of ponded water; and
- final lift or layer thickness.

6.8 Hydraulic Conductivity Testing Evaluations

As shown in Tables 6-1 and 6-2, hydraulic conductivity (permeability) tests shall be conducted on materials proposed for use as the soil component of the compacted clay liner and cap as well as the soil materials which shall comprise the LDS, LCS, and cover drainage layers. Permeability testing of compacted clay liner and cap materials shall be accomplished in accordance with ASTM 5084 at a confining stress of 5 psi. Permeability testing of the LDS, LCS, and cover drainage layers shall be performed in accordance with ASTM D 2434. Laboratory remolded samples shall be used for conformance evaluation of the clay liner and cap materials prior to construction. The CQC Consultant shall be responsible for documenting pertinent sampling information including the date the sample was obtained, sample identification number, and location.

6.9 Performance Testing

During construction, the CQC Consultant shall observe and test the soil components of the OSDF liner and cover systems to ensure they are installed in accordance with the requirements of the Construction Drawings and Technical Specifications. The CQC Consultant shall also evaluate the procedures, methods, and equipment used by the Subcontractor to install the various soil components.

6.9.1 Test Methods

All performance testing shall be conducted in accordance with the Technical Specifications or as directed by the Construction Manager. The CQC field testing methods, used to evaluate the suitability of soils during their installation, shall be performed by the CQC Consultant in accordance with current ASTM test procedures indicated in Tables 6-3 and 6-4. Test results shall be documented and reported to the Construction Manager.

6.9.2 Test Frequency

Performance testing shall be conducted during the course of the work. The minimum construction performance testing frequencies are presented in Tables 6-3, and 6-4. The frequency may be increased at the discretion of the Construction Manager or if variability of the materials is observed by the CQC Consultant. Sampling locations shall be selected by the CQC Consultant. If necessary, the location of routine in-place density tests shall be determined using a non-biased sampling approach.

A special testing frequency shall be used at the discretion of the Construction Manager when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas shall be considered when:

- rollers slip during rolling operation;
- lift thickness is greater than specified;
- earthfill is at improper and/or variable moisture content;
- it is suspected that less than the specified number of roller passes are made;
- dirt-clogged rollers are used to compact the material;
- rollers may not have used optimum ballast;
- fill materials differ substantially from those specified;
- the degree of compaction is doubtful; and
- as directed by the Construction Manager

During construction, the frequency of testing may also be increased in the following situations:

- adverse weather conditions;
- breakdown of equipment;
- at the start and finish of grading;
- material fails to meet specifications; and
- the work area is reduced.

6.10 Clay Liner and Cap Perforations

Perforations that must be filled shall include, but not be limited to, the following:

- in-place density test probe locations;
- sand cone or drive test locations;
- survey stake locations; and
- test pit locations.

Perforations in the compacted clay liner and cap resulting from field tests or other construction activities, as described above, shall be filled in accordance with the requirements of Section 02225 of the Technical Specifications and this CQA Plan. Additional density and moisture testing of these areas, if required, shall be conducted at the discretion of the Construction Manager.

6.11 Field Equipment Decontamination

The CQC Consultant shall perform decontamination of field equipment used in the sampling and testing of soils known or suspected of containing low-level radioactive wastes in accordance with the procedures outlined in ASTM D 5608. The practice of decontamination is applicable to most conventional sampling or field testing equipment constructed of metallic and hard, smooth synthetic materials. Materials with rough or porous surfaces, or having a sorption rate, should not be used due to the difficulties with decontaminations.

6.12 Deficiencies

If a defect is discovered in the soils construction, the CQC Consultant shall immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQC Consultant shall determine the extent of the deficient area by additional tests, observations, a review of records, or other means that the CQC Consultant deems appropriate. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQC Consultant shall define the limits and nature of the defect.

6.12.1 Notification

As soon as possible, after determining the extent and nature of substandard materials, noncompliant construction practice, or other such deficiency in materials or workmanship which cannot be immediately resolved on-the-spot, the CQC Consultant shall notify the Construction Manager and Subcontractor and schedule appropriate retests when the work deficiency is to be corrected.

6.12.2 Repairs and Retesting

The CQC Consultant shall verify that the Subcontractor has corrected all noted deficiencies to the satisfaction of the Construction Manager. If a specified criterion cannot be met, or unusual weather conditions hinder work, the Subcontractor shall submit suggested solutions or alternatives to the Construction Manager for review.

At locations where the field testing indicates in-situ conditions which do not comply with the requirements of the Technical Specifications, the failing area shall be reworked to the satisfaction of the Construction Manager. Alternatively, at the Construction Manager's option, undisturbed samples of in-place material shall be obtained for hydraulic conductivity or other appropriate testing. All retests performed by the CQC Consultant must verify that the deficiency has been corrected before any additional work is performed by the Subcontractor in the area of the deficiency.

6.13 Documentation

The documentation of soils CQC testing activities is an important factor in assuring the successful construction, performance, and approval of the OSDF soil liner and closure system components. The CQC monitoring observations, sample location descriptions, field test results, and on-site laboratory test results shall be documented by the CQC Consultant on forms similar to the examples included in Appendix A. Reports and forms shall be provided to the Construction Manager as requested. Weekly reports shall be regularly submitted to the Construction Manager.

TABLE 6-1
MINIMUM CONFORMANCE TESTING FREQUENCIES FOR OSDF LINER SYSTEM COMPONENTS

TEST NAME/TEST METHOD	SOIL TYPE			
	COMPACTED FILL	COMPACTED CLAY LINER	GRANULAR DRAINAGE MATERIAL	EMBEDMENT FILL
SPECIFICATION SECTION	02200	02225	02710	02215
Particle Size Analysis/ASTM D 422 (sieve only)	1 test per 5,000 yd^3	1 test per 1,500 yd^3 [1]	N/A	N/A
Particle Size Analysis/ASTM C 136	N/A	N/A	1 test per 3,000 yd^3	1 test per 1,000 yd^3
Atterberg Limits/ASTM D 4318	1 test per 5,000 yd^3	1 test per 1,500 yd^3	N/A	N/A
Moisture Content/ASTM D 2216 or ASTM D 4643	1 test per 5,000 yd^3	1 test per 1,500 yd^3	N/A	
Soil Classification/ASTM D 2487	1 test per 5,000 yd^3	1 test per 1,500 yd^3	1 test per 3,000 yd^3	1 test per 1,000 yd^3
Standard Proctor/ASTM D 698	1 test per 5,000 yd^3	1 test per 1,500 yd^3	N/A	N/A
Hydraulic Conductivity/ASTM D 5084	N/A	1 test per 10,000 yd^3 (remold sample)[3]	N/A	N/A
Hydraulic Conductivity/ASTM D 2434	N/A	N/A	1 test per 3,000 yd^3	N/A
Carbonate Content/ASTM D 3042[2]	N/A	N/A	1 test per 5,000 yd^3	N/A
Organic Content/ASTM D 2974	N/A	N/A	N/A	N/A

NA = Not Applicable

NOTE: 1. Also perform hydrometer analysis once every tenth test.

2. Sample to be tested at pH of 4.

3. For Phase I, the frequency shall be 1 test per 1,500 yd^3. This frequency shall be evaluated for modification during later phases.

TABLE 6-2
MINIMUM CONFORMANCE TESTING FREQUENCIES FOR OSDF COVER SYSTEM COMPONENTS

TEST NAME/TEST METHOD	SOIL TYPE						
	COMPACTED CLAY CAP	COVER DRAINAGE LAYER	BIOINTRUSION BARRIER		GRANULAR FILTER	VEGETATIVE SOIL LAYER	TOPSOIL
			PRIMARY BIOINTRUSION BARRIER	CHOKE STONE			
SPECIFICATION SECTION	02225	02710	02280	02280	02712	02250	02920
Particle Size Analysis/ASTM D 422 (sieve only)	1 test per 1,500 yd^3 [1]	N/A	N/A	N/A	N/A	1 per 5,000 yd^3	1 per 5,000 yd^3 [3]
Particle Size Analysis/ASTM C 136	N/A	1 test per 3,000 yd^3	N/A	1 test per 10,000 yd^3	1 test per 5,000 yd^3	N/A	N/A
Moisture Content/ASTM D 2216 or ASTM D 4643	1 test per 1,500 yd^3	N/A	N/A	N/A	N/A	N/A	N/A
Soil Classification/ASTM D 2487	1 test per 1,500 yd^3	1 test per 3,000 yd^3	N/A	N/A	1 test per 5,000 yd^3	1 test per 5,000 yd^3	1 test per 5,000 yd^3
Standard Proctor/ASTM D 698	1 test per 1,500 yd^3	N/A	N/A	N/A	N/A	1 test per 5,000 yd^3	N/A
Hydraulic Conductivity/ASTM D 5084	1 test per 1,500 yd^3 (remold)	N/A	N/A	N/A	N/A	N/A	N/A
Hydraulic Conductivity/ASTM D 2434	N/A	1 test per 3,000 yd^3	N/A	N/A	N/A	N/A	N/A
Carbonate Content/ASTM D 3042[2]	N/A	1 test per 5,000 yd^3				N/A	N/A
Organic Content/ASTM D 2974	N/A	N/A	N/A	N/A	N/A	N/A	1 test per 5,000 yd^3

N/A = Not Applicable

NOTE: 1. Also, perform hydrometer analysis once every tenth test.

2. Sample to be tested at pH of 4.

3. Perform hydrometer analysis for each test.

TABLE 6-3
PERFORMANCE TESTING FREQUENCIES FOR OSDF LINER SYSTEM COMPONENTS

TEST NAME/TEST METHOD	COMPACTED FILL	TRENCH BACKFILL	ANCHOR TRENCH BACKFILL	COMPACTED CLAY LINER	GRANULAR DRAINAGE MATERIALS
SPECIFICATION SECTION	02200	02215	02215	02225	02710
In-situ Moisture/ASTM D 3017	2 tests per acre per lift[1]	1 test per 250 lineal ft per lift	1 test per 250 lineal ft per lift	5 tests per acre per lift[1]	N/A
In-situ Density/ASTM D 2922	2 tests per acre per lift[1]	1 test per 250 lineal ft per lift	1 test per 250 lineal ft per lift	5 tests per acre per lift[1]	N/A
Sand Cone/ASTM D 1556	1 test per 25 nuclear tests	N/A	N/A	1 test per 25 nuclear tests	N/A

N/A = Not Applicable

NOTE: 1 A minimum of two nuclear moisture and density tests each day of active soils construction

TABLE 6-4
MINIMUM PERFORMANCE TESTING FREQUENCIES FOR OSDF COVER SYSTEM COMPONENTS

TEST NAME/TEST METHOD	SOIL TYPE						
	COMPACTED CLAY CAP	COVER DRAINAGE LAYER	BIOINTRUSION BARRIER		GRANULAR FILTER	VEGETATIVE SOIL LAYER	TOPSOIL
			PRIMARY BIOINTRUSION BARRIER	CHOKE STONE			
SPECIFICATION SECTION	02225	02710	02280	02280	02712	02250	02920
In-situ Moisture/ASTM D 3017	5 tests per acre per lift[1]	N/A	N/A	N/A	N/A	2 tests per acre per lift[1]	N/A
In-situ Density/ASTM D 2922	5 tests per acre per lift[1]	N/A	N/A	N/A	N/A	2 tests per acre per lift[1]	N/A
Sand Cone/ASTM D 1556	1 test per 25 nuclear tests	N/A	N/A	N/A	N/A	1 test per 25 nuclear tests	N/A

N/A = Not Applicable

NOTE 1 A minimum of two nuclear moisture and density tests each day of active soils construction

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7. GEOMEMBRANE LINER AND COVER

7.1 Introduction

The CQC Consultant shall perform conformance testing and shall monitor the installation of geomembranes as required by Section 02770 of the Technical Specifications and this CQA Plan. The testing used to evaluate the conformance of the geomembrane with the requirements of the Technical Specifications shall be carried out by the CQC Consultant in accordance with the current versions of the ASTM or other applicable test procedure indicated in Tables 7-1 and 7-2.

7.2 Related Construction Drawings and Technical Specifications

The Subcontractor shall comply with Section 02770 of the Technical Specifications. This specification shall be referenced for the various physical properties, manufacturing quality control, and installation requirements of the geomembrane materials.

7.3 Manufacturing Plant Visit

The Construction Manager, or authorized representative (i.e., the CQC Consultant), shall visit the plant of the Geomembrane Manufacturer for the purpose of verifying manufacturing quality control procedures are in conformance with Section 02770 of the Technical Specifications. If possible, such a visit shall be performed prior to or during the manufacturing of the geomembrane rolls for the OSDF project. The Construction Manager shall review the manufacturing process, quality control procedures, laboratory facilities, and testing procedures.

During the project specific plant visit, the Construction Manager shall:

- verify that properties guaranteed by the Geosynthetics Manufacturer meet all specifications;
- verify that the measurements of properties by the Geosynthetics Manufacturer are properly documented and test methods used are acceptable;
- spot inspect the rolls and verify that they are free of holes, blisters, or any sign of contamination by foreign matter;
- review packaging and transportation procedures to verify that these procedures are not damaging the geomembrane;
- verify that all rolls are properly labeled; and
- verify that extrusion rods and/or beads manufactured for the field seaming of the geomembrane are derived from the same base resin type as the geomembrane.

Upon completion of the manufacturing plant visit, a report describing the findings and observations shall be completed by the Construction Manager.

7.4 Transportation, Handling and Storage

The CQC Consultant shall monitor the transportation, handling, and storage of the geomembrane on-site. The Construction Manager shall designate a geomembrane storage location. It will be the responsibility of the Subcontractor to protect the geomembrane stored on site from theft, vandalism, and damage.

Upon delivery at the site, the Subcontractor, Geosynthetics Installer, and CQC Consultant shall conduct an inspection of the rolls for defects and damage. This

inspection shall be conducted without unrolling the materials unless defects or damages are found or suspected. The CQC Consultant shall indicate to the Construction Manager:

- rolls, or portions thereof, which should be rejected and removed from the site because they have severe or nonrepairable flaws which may compromise geomembrane quality; and

- rolls which include minor or repairable flaws which do not compromise geomembrane quality.

The CQC Consultant shall also monitor that equipment used to handle the geomembrane on-site is adequate and does not pose any risk of damage to the geomembrane when used properly.

7.5 Conformance Testing

7.5.1 Sampling Procedures

Upon delivery of the geomembrane rolls to the OSDF, the CQC Consultant shall ensure that representative geomembrane conformance samples are obtained at the specified frequency and forwarded to the Geosynthetics CQC Laboratory for testing. Geomembrane conformance samples shall be taken across the entire width of the roll and shall not include the first 3 ft of material. Unless otherwise directed by the Construction Manager, samples shall be 3 ft long by the roll width. The required minimum geomembrane conformance sampling frequencies are provided in Table 7-1. The CQC Consultant shall mark the machine direction on the samples with an arrow and affix a label, tag, or otherwise mark each sample with the following information:

- date sampled;

- project number;

- lot/batch number and roll number;
- conformance sample number; and
- CQC personnel identification.

7.5.2 Testing Procedures

Conformance testing of the geomembrane materials delivered to the site will be conducted to ensure compliance with both the Technical Specifications and the manufacturer's list of minimum average roll values. As a minimum, the geomembrane conformance test procedures listed in Table 7-1 shall be performed by the Geosynthetics CQC laboratory.

7.5.3 Test Results

All conformance test results shall be reviewed, accepted, and reported by the CQC Consultant before deployment of the geomembrane. Any nonconformance of the material's physical properties with the requirements of the Technical Specifications shall be reported to the Construction Manager. In all cases, the test results shall meet, or exceed, the property values listed in Appendix B.

7.5.4 Conformance Test Failure

In the case of failing test results, the Subcontractor may request that another sample from the failing roll be retested by the Geosynthetics CQC laboratory with the manufacturer's technical representative present during the test procedure. If the retest fails or if the option to retest is not exercised, then two isolation conformance samples shall be obtained by the CQC Consultant. These isolation samples shall be taken from rolls, which have been determined by correlation with the manufacturer's roll number,

to have been manufactured prior to and after the failing roll. This method for choosing isolation rolls for testing should continue until passing tests are achieved. All rolls which fail numerically between the passing roll numbers shall be rejected by the Construction Manager. The CQC Consultant will verify that the Subcontractor has replaced all rejected rolls. The CQC Consultant shall document all actions taken in conjunction with geomembrane conformance failures.

7.6 Anchorage Trench

The CQC Consultant shall verify and document that the anchor trench has been constructed according to Construction Drawings. The amount of anchor trench open at any time shall be limited to one day of geomembrane installation capacity. The anchor trench shall be constructed with proper drainage to prevent ponding.

Geosynthetic materials in the anchor trench shall be temporarily anchored with sand bags or other suitable methods approved by the Construction Manager. The anchor trench shall be backfilled with suitable material as indicated in the Construction Drawings and Technical Specifications. In-place moisture/density by nuclear methods testing of the compacted anchor trench backfill shall be performed at the frequencies given in Table 6-3.

The anchor trench shall be constructed with a slightly rounded inside corner where the geosynthetics enter the trench. No loose soil shall be allowed to underlie the geosynthetics in the anchor trench. The CQC Consultant shall verify that all temporary ballast (i.e., sandbags) and deleterious materials are removed from the anchor trench prior to backfilling. Backfilling of the anchor trench shall be performed when the geomembrane is in its most contracted state to prevent stress inducement and using extreme care to prevent any damage to the geosynthetic materials.

7.7 Geomembrane Placement

7.7.1 Field Panel Identification

A field panel is the unit area of geomembrane which is to be seamed in the field, i.e., a field panel is a roll or a portion of roll cut in the field.

The CQC Consultant shall assure that each field panel is given an "identification code" (number or letter-number) consistent with the layout plan. This identification code shall be agreed upon by the Construction Manager, Geosynthetics Installer, and CQC Consultant. This field panel identification code shall be as simple and logical as possible. The Geosynthetic Manufacturer's roll numbers shall be traceable to the field panel identification code.

The CQC Consultant shall document the correspondence between roll numbers, factory panels, and field panel identification codes. The field panel identification code shall be used for all quality assurance/quality control records.

7.7.2 Field Panel Placement

The CQC Consultant shall monitor that field panels are installed at the location indicated in the Geosynthetics Installer's layout plan, as approved or modified. The CQC Consultant shall record the field panel identification code, manufacturers roll number, location, date of installation, and dimensions of each field panel.

Geomembrane placement shall not proceed at an ambient temperature below 40°F or above 104°F unless authorized in writing by the Construction Manager. Geomembrane placement shall not proceed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds. The CQC Consultant shall monitor that the above conditions are fulfilled and that the supporting soil has not been damaged by adverse weather conditions.

The CQC Consultant shall monitor geomembrane deployment for the following:

- any equipment used does not damage the geomembrane by handling, trafficking, excessive heat, leakage of hydrocarbons or other means;
- the prepared surface underlying the geomembrane has not deteriorated since previous acceptance, and is still acceptable immediately prior to geomembrane placement;
- any geosynthetic elements immediately underlying the geomembrane are clean and free of foreign objects or debris;
- all personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities which could damage the geomembrane;
- the method used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil;
- the method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels);
- adequate temporary loading and/or anchoring (e.g., sand bags, tires), not likely to damage the geomembrane, has been placed to prevent uplift by wind (in case of high winds, continuous loading, e.g., by adjacent sand bags, is recommended along edges of panels to minimize risk of wind flow under the panels); and
- direct contact with the geomembrane is minimized; i.e., the geomembrane is protected by geotextiles, extra geomembrane, or other suitable materials, in areas where excessive traffic may be expected.

The CQC Consultant shall observe the geomembrane panels, after placement and prior to seaming, for damage. The CQC Site Manager shall advise the Construction

Manager which panels, or portions of panels, should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels which have been rejected shall be marked and their removal from the work area recorded by the CQC Consultant. Repairs shall be made according to procedures described in this Section.

7.8 Field Panel Seaming

7.8.1 Panel Layout

The CQC Consultant shall review the panel layout drawing previously submitted to the Construction Manager by the Geosynthetics Installer and verify that it is consistent with accepted state of practice. In general, seams should be oriented parallel to the line of maximum slope, i.e., oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of seams should be minimized. No horizontal seam should be less than 10 ft from the toe of the slope, or areas of potential stress concentrations, unless otherwise authorized by the Construction Manager. A seam numbering system compatible with the field panel identification numbering system shall be agreed upon prior to any seaming.

7.8.2 Seaming Equipment and Products

Approved processes for field seaming are extrusion welding and fusion welding. Proposed alternate processes shall be documented and submitted to the Construction Manager for approval. Only equipment which have been specifically recommended by the Manufacturer by make and model shall be used. All seaming equipment shall be permanently marked with an identification number.

7.8.2.1 Filet Extrusion Process

The filet extrusion-welding apparatus shall be equipped with gauges giving the temperature in the apparatus and at the nozzle. The CQC Consultant shall verify that the extrudate is comprised of the same resin as the geomembrane sheeting. The CQC Consultant shall monitor temperatures, extrudate temperatures, ambient temperatures, and geomembrane surface temperatures at appropriate intervals.

The CQC Consultant shall also monitor that:

- the number of spare operable seaming apparatus agreed by the Construction Manager are maintained on site;
- equipment used for seaming is not likely to damage the geomembrane;
- the extruder is purged prior to beginning a seam until all heat-degraded extrudate has been removed from the barrel;
- the electric generator is placed on a smooth base such that no damage occurs to the geomembrane; and
- a smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage.

7.8.2.2 Fusion Process

The fusion-welding apparatus must be automated, self-propelled devices. The fusion-welding apparatus shall be equipped with gauges giving the applicable temperatures and welding speed. The CQC Consultant shall monitor ambient temperatures, and apparatus temperatures.

The CQC Consultant shall also monitor that:

- the number of spare operable seaming apparatus agreed by the Construction Manager are maintained on site;
- equipment used for seaming will not damage the geomembrane;
- the electric generator is placed on a smooth base such that no damage occurs to the geomembrane;
- for cross seams, the edge of the cross seam is ground to a smooth incline (top and bottom) prior to welding;
- a smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage; and
- a movable protective layer is used as necessary directly below each overlap of geomembrane that is to be seamed to prevent build-up of moisture between the sheets.

7.8.3 Seam Preparation

The CQC Consultant shall monitor that:

- prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material;
- seams are overlapped a minimum of 4 inches;
- if seam overlap grinding is required, the process is completed according to the Geomembrane Manufacturer's instructions or Section 02770 of the

Technical Specifications, whichever is the more stringent, prior to the seaming operation, and in a way that does not damage the geomembrane;

- the grind depth shall not exceed 10 percent of the geomembrane thickness;
- grinding marks shall not appear beyond the extrudate after it is placed; and
- seams are aligned with the fewest possible number of wrinkles and "fishmouths".

7.8.4 Weather Conditions for Seaming

The normally required weather conditions for seaming are as follows:

- Unless authorized in writing by the Construction Manager, no seaming shall be attempted at an ambient temperature below 40°F or above 104°F.
- Between ambient temperatures of 40°F and 50°F, seaming is possible if the geomembrane is preheated by either sun or hot air device, and if there is no cooling of the geomembrane to below 50°F resulting from wind.
- In all cases, the geomembrane seam areas shall be dry and protected from wind.

The CQC Consultant shall verify that methods used by the Subcontractor for seaming at ambient temperatures below 40°F or above 104°F will produce seams which are entirely equivalent to seams produced at ambient temperatures between 40°F and 104°F and protect the overall quality of the geomembrane. The CQC Consultant shall monitor that seaming conducted during abnormal weather conditions is performed in accordance with the methods approved by the Construction Manager.

7.8.5 Overlapping and Temporary Bonding

The CQC Consultant shall monitor that:

- the panels of geomembrane have a finished overlap of a minimum of 4 in. for both extrusion and fusion welding, but in any event sufficient overlap shall be provided to allow peel tests to be performed on the seam;

- no solvent or adhesive is used unless the product is approved in writing by the Construction Manager (samples shall be submitted to the Construction Manager for testing and evaluation); and

- the procedure used to temporarily bond adjacent panels together does not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any spot welding apparatus is controlled such that the geomembrane is not damaged.

7.8.6 Trial Seams

The CQC Consultant shall verify that the Geosynthetics Installer performs trial seam tests in accordance with Section 02770 of the Technical Specifications. The CQC Consultant shall observe and document the Geosynthetic Installers trial seam testing procedures. The trial seam samples shall be assigned an identification number and marked accordingly by the CQC Consultant. Each sample shall be marked with the date, time, machine temperature(s) and setting(s), number of seaming unit, and name of seaming technician. Trial seam samples shall be maintained by the Subcontractor until a passing destructive test is achieved on seam represented by the trial seam sample.

7.8.7 General Seaming Procedures

No geomembrane seaming shall be performed unless the CQC Consultant is on-site. The CQC Consultant shall monitor the general seaming procedure used by the Geosynthetics Installer as follows:

- For fusion welding, a movable protective layer of plastic may be required to be placed directly below each overlap of geomembrane that is to be seamed. This is to prevent any moisture build-up between the sheets to be welded.

- If required, a firm substrate shall be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

- Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 in. beyond the cut in all directions.

- If seaming operations are carried out at night, adequate illumination shall be provided by the Subcontractor to the satisfaction of the Construction Manager.

- Seaming shall extend to the outside edge of panels to be placed in the anchor trench.

7.8.8 Nondestructive Seam Continuity Testing

The CQC Consultant shall monitor that the Geosynthetics Installer shall nondestructively test all field seams over their full length using a vacuum test unit or air pressure test (for double fusion seams only). Spark testing may be performed if the

seam cannot be tested using the vacuum or air pressure test methods. The purpose of nondestructive tests is to check the continuity of seams. Continuity testing shall be carried out as the seaming work progresses, not at the completion of all field seaming. The CQC Consultant shall:

- monitor nondestructive testing;
- document the results of the nondestructive testing; and
- inform the Subcontractor and Construction Manager of any noncompliance.

Any required seam repairs shall be made in accordance with the Technical Specifications. The CQC Consultant shall:

- observe the repair procedures;
- observe the retesting procedures; and
- document the results.

The seam number, date of observation, dimensions and/or descriptive location of the seam length tested, name of person performing the test, and outcome of the test shall be recorded by the CQC Consultant.

7.8.9 Destructive Testing

Destructive seam testing shall be performed during the geomembrane installation. The purpose of this testing is to evaluate seam strength. Destructive seam testing shall be done as the seaming work progresses, not at the completion of all field seaming.

7.8.9.1 Location and Frequency

The CQC Consultant shall select all destructive seam test sample locations. Sample locations shall be established as follows.

- A minimum frequency of one test location per 500 ft of seam length. This minimum frequency is to be determined as an average taken throughout the entire facility.

- Test locations shall be determined during seaming at the CQC Consultants discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential cause of imperfect welding.

The Geosynthetics Installer shall not be informed in advance of the locations where the seam samples will be taken.

7.8.9.2 Sampling Procedures

Destructive seam testing shall be performed as the seaming progresses in order to obtain the Geosynthetic CQC Laboratory test results before the geomembrane is covered by overlying materials. The CQC Consultant shall:

- observe sample cutting;

- assign a number to each sample, and mark it accordingly; and

- record sample location on layout drawing.

All holes in the geomembrane resulting from destructive seam test sampling shall be immediately repaired in accordance with repair procedures described in

The CQC Consultant shall witness all field tests and mark all samples and portions with their number. The CQC Consultant shall also log the date, number of seaming unit, seaming technician identification, destructive sampling, and pass or fail description.

7.8.9.5 Geosynthetics CQC Laboratory Testing

Destructive test samples shall be tested by the Geosynthetics CQC Laboratory. Testing shall include "Bonded Seam Strength" and "Peel Adhesion" (ASTM D 4437). The minimum acceptable values to be obtained in these tests are presented in Appendix B. At least five specimens shall be tested for each test method. Specimens shall be selected alternately by test from the samples (i.e., peel, shear, peel, shear...). Both the inside and outside tracks of the double track fusion seams shall be tested for peel adhesion. A passing test shall meet the minimum required values in at least four out of five specimens.

The Geosynthetics CQC Laboratory shall provide test results no more than 24 hours after they receive the samples. The CQC Site Manager shall review laboratory test results as soon as they become available, and make appropriate recommendations to the Construction Manager.

7.8.9.6 Procedures for Destructive Test Failure

The following procedures shall apply whenever a sample fails a destructive test, whether that test was conducted in the field or by the Geosynthetics CQC Laboratory. The CQC Consultant will monitor that the Geosynthetics Installer follow one of two options:

- The Geosynthetics Installer can reconstruct the seam (e.g., remove the old seam and reseam) between any two passed destructive test locations.

- The Geosynthetics Installer can trace the welding path to an intermediate location a minimum of 10 ft from the point of the failed test in each direction and take a small sample for an additional field testing in accordance with the destructive test procedure at each location. If these additional isolation samples pass the field test, then full laboratory samples are taken at both locations. If these laboratory samples meet the specified strength criteria, then the seam is reconstructed between these locations. If either sample fails, then the process is repeated to establish the zone in which the seam should be reconstructed.

All failed seams must be bounded by two locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 150 ft of reconstructed seam, a sample taken from the zone in which the seam has been reconstructed must pass destructive testing. Repairs shall be made in accordance with this Section. The CQC Consultant shall document all actions taken in conjunction with destructive test failures.

7.9 Defects and Repairs

7.9.1 Identification

All seams and non-seam areas of the geomembrane shall be examined by the CQC Consultant for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane shall be clean at the time of examination. The Construction Manager shall require the geomembrane surface to be broomed or washed by the Subcontractor if the amount of dust or mud inhibits examination.

7.9.2 Repair Procedures

Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired by the Geosynthetics Installer in accordance with Section 02770 of the Technical Specifications. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be agreed upon between the Subcontractor and Construction Manager.

In addition, the following conditions shall be monitored by the CQC Consultant:

- surfaces of the geomembrane which are to be repaired shall be abraded no more than one hour prior to the repair;
- all surfaces must be clean and dry at the time of the repair;
- all seaming equipment used in repairing procedures must be approved;
- the repair procedures, materials, and techniques shall be approved by the Construction Manager in advance of the specific repair;
- patches or caps shall extend at least 6 in. beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 in.; and
- the geomembrane below large caps should be appropriately cut to avoid water or gas collection between the two sheets.

7.9.3 Verification of Repairs

Each repair shall be numbered and logged. Each repair shall be non-destructively tested using approved methods. Repairs which pass the non-destructive test shall be taken as an indication of an adequate repair. Large caps may be of sufficient extent to

specified in Table 7-2. The CQC Consultant shall observe all non-destructive testing of repairs and shall record the number of each repair, date, and test outcome.

7.10 Liner and Cover System Acceptance

The Subcontractor shall retain all responsibility for the geosynthetics until acceptance by the Construction Manager. The terms for liner system acceptance are described in Section 02770 of the Technical Specifications.

7.11 Materials in Contact with the Geomembrane

The procedures outlined in this section are intended to assure that the installation of materials in contact with the geomembrane do not cause damage. Additional quality assurance and quality control procedures are necessary to assure that systems built with these materials will be constructed in such a way to ensure proper performance.

7.11.1 Soils

The CQC Consultant shall monitor that the Subcontractor takes all necessary precautions to ensure that the geomembrane is not damaged during its installation or during the installation of other components of the liner or cover system or by other construction activities. The CQC Consultant shall monitor the following:

- placement of granular drainage materials above the geomembrane which shall not proceed at an ambient temperature below 40°F or above 104°F unless otherwise approved by the Construction Manager;

- soil placement operations above the geomembrane which shall be made by the Subcontractor to minimize wrinkles in the geomembrane;

- equipment used for placing soil shall not be driven directly on the geomembrane;

- a minimum soil thickness of 1 ft is used between a light track-mounted dozer (e.g., having a maximum ground pressure of 5 psi) and the geomembrane;

- a minimum thickness of 3 ft of soil is used between rubber-tired vehicles and the geomembrane; and

- soil thickness shall be greater than 3 ft in heavily trafficked areas such as access ramps.

7.11.2 Appurtenances

The CQC Consultant shall monitor that:

- installation of the geomembrane in appurtenant areas, and connection of geomembrane to sumps and appurtenances have been made in accordance with the Construction Drawings and Technical Specifications;

- extreme care is taken by the Geosynthetics Installer when seaming around appurtenances since neither non-destructive nor destructive testing may be feasible in these areas; and

- the geomembrane has not been visibly damaged when making connections to sumps and appurtenances;

TABLE 7-1:

GEOMEMBRANE CONFORMANCE TESTING REQUIREMENTS

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY[1]
Specific Gravity	ASTM D792 Method A or ASTM D1505	1 test per 100,000 ft^2
Thickness	ASTM D 519 or GRI-GM8	1 test per 100,000 ft^2
Tensile Strength at Yield	ASTM D638	1 test per 100,000 ft^2
Tensile Strength at Break	ASTM D638	1 test per 100,000 ft^2
Elongation at Yield	ASTM D638	1 test per 100,000 ft^2
Elongation at Break	ASTM D638	1 test per 100,000 ft^2
Carbon Black Content	ASTM D1603	1 test per 100,000 ft^2
Carbon Dispersion	ASTM D5596	1 test per 100,000 ft^2

Notes: 1. Test shall be performed at a frequency of one per lot or at listed frequency, whichever is greater. A lot shall be as defined by ASTM 4354.

TABLE 7-2:

GEOMEMBRANE SEAM TESTING REQUIREMENTS

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY
Peel Adhesion	ASTM D4437[1,3]	1 test every 500 ft of seam length
Bonded Seam Strength	ASTM D4437[2,3]	1 test every 500 ft of seam length
Vacuum Testing	—	100 percent of extrusion welded seams
Air Pressure Testing	—	100 percent of fusion welded seams

Notes:

1. For peel adhesion, seam separation shall not extend more than 10 percent into the seam interface. Testing shall be discontinued when the sample has visually yielded.

2. For shear tests, the sheet shall yield before failure of the seam.

3. For either test, sample failure shall be a Film Tear Bond (FTB) as outlined in NSF 54, Appendix A.

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8. GEOSYNTHETIC CLAY LINER AND CAP

8.1 Introduction

The CQC Consultant shall perform conformance testing and shall monitor the installation of the geosynthetic clay liner (GCL) and geosynthetic clay cap (GCC) as required by Section 02772 of the Technical Specifications and this CQA Plan. The testing used to evaluate the conformance of the GCL and GCC with the requirements of the Technical Specifications shall be performed by the CQC Consultant in accordance with the current versions of the ASTM or other applicable test procedure indicated in Table 8-1.

8.2 Related Construction Drawings and Technical Specifications

The Subcontractor shall comply with Section 02772 of the Technical Specifications. This specification shall be referenced for the various physical properties, manufacturing quality control, and installation requirements of the GCL and GCC materials.

8.3 Transportation, Handling, and Storage

The CQC Consultant shall monitor the transportation, handling, and storage of the GCL and GCC on-site. Handling of the rolls shall be performed in a competent manner such that damage does not occur to the GCL and GCC or its protective wrapping. Any protective wrapping that is damaged or stripped off the rolls shall be repaired immediately to the satisfaction of the Construction Manager. During transportation, handling, and storage the GCL and GCC rolls will be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

Upon delivery at the site, the Subcontractor, Geosynthetics Installer, and CQC Consultant shall conduct an inspection of the rolls for defects and damage. This inspection shall be conducted without unrolling the materials unless defects or damages are found or suspected. The CQC Consultant shall indicate to the Construction Manager:

- rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws; and
- rolls which include minor repairable flaws.

The CQC Consultant shall also monitor that equipment used to handle the geosynthetics on-site is adequate and does not pose any risk of damage to the geosynthetics when used properly.

8.4 Conformance Testing

8.4.1 Sampling Procedures

Upon delivery of the rolls of GCL and GCC, the CQC Consultant will assure that samples are removed and forwarded to the Geosynthetic CQC Laboratory for testing of conformance to both the design specifications and the list of guaranteed properties provided by the manufacturer. Unless otherwise directed by the Construction Manager, conformance samples will be 3 ft long by the roll width. The CQC Consultant will mark the machine direction on the samples with a waterproof maker and tap or otherwise secure the cut edges of the sample to eliminate the loss of the granular bentonite. The required minimum sampling frequencies are provided in Table 8-1. The rolls shall be immediately re-wrapped and replaced in their shipping trailers or in the temporary field storage area. The CQC Consultant shall mark the machine direction on the samples with an arrow and affix a label, tag, or otherwise mark each sample with the following information:

- date sampled;
- project number;
- lot/batch number and roll number;
- conformance sample number; and
- CQC personnel identification.

8.4.2 Testing Procedure

Conformance testing of the GCL and GCC materials delivered to the site will be conducted to ensure compliance with both the Technical Specifications and the manufacturer's list of minimum average roll values. As a minimum, the GCL and GCC conformance test procedures listed in Table 8-1 shall be performed by the Geosynthetics CQC laboratory.

8.4.3 Test Results

The CQC Consultant will examine all results from laboratory conformance testing and will report any nonconformance to the Construction Manager. The GCL and GCC conformance test result shall meet or exceed the minimum physical property values presented in Appendix C.

8.4.4 Conformance Test Failure

In the case of failing test results, the Subcontractor may request that another sample from the failing roll be retested by the Geosynthetics CQC laboratory with the manufacturer's technical representative present during the test procedure. If the retest

fails or if the option to retest is not exercised, then two isolation conformance samples shall be obtained by the CQC Consultant. These isolation samples shall be taken from rolls, which have been determined by correlation with the manufacturer's roll number, to have been manufactured prior to and after the failing roll. This method for choosing isolation rolls for testing should continue until passing tests are achieved. All rolls which fail numerically between the passing roll numbers shall be rejected by the Construction Manager. The CQC Consultant will verify that the Subcontractor has replaced all rejected rolls. The CQC Consultant shall document all actions taken in conjunction with GCL and GCC conformance failures.

8.5 Surface Preparation

The GCL and GCC shall not be placed on surfaces which are softened due to high water content or cracked due to desiccation. The CQC Consultant and the Geosynthetics Installer will jointly verify that the surface on which the GCL and GCC will be installed is acceptable. The Subcontractor shall comply with the compacted clay liner surface preparation and acceptance requirements identified in Section 02225 of the Technical Specifications. Additionally, the surface shall contain no loose stones and no ruts greater than 1/2-in. depth. The CQC Consultant shall notify the Construction Manager of any observed change in the supporting soil condition that may require repair work and verify that compacted clay liner repair work is completed in accordance with the requirements of the Technical Specifications and this CQA Plan.

8.6 Placement

The CQC Consultant shall verify that the Geosynthetics Installer has taken all necessary precautions to protect the underlying subgrade during GCL and GCC deployment operations. The CQC Consultant shall verify that all GCL and GCC are handled in such a manner as to ensure they are not damaged in any way, and the following conditions are met:

- on slopes, the GCL and GCC are secured and then rolled down the slope in such a manner as to continually keep the GCL and GCC panel in tension and prevent loss of bentonite;

- in the presence of wind, all GCL and GCC are weighted with sandbags or the equivalent;

- GCL and GCC are kept continually under tension to minimize the presence of wrinkles;

- GCL and GCC are cut using a utility blade in a manner recommended by the Manufacturer;

- during placement, care is taken not to entrap fugitive clay, sand, stones other debris under the GCL and GCC;

- the exposed GCL and GCC are protected from damage in heavily trafficked areas;

- a visual examination of the GCL and GCC is carried out over the entire surface, after installation, to assure that damaged areas, if any, are identified and repaired; and

- if a white colored GCL and GCC is used, precautions are taken against "snowblindness" of personnel.

8.7 Overlaps

The CQC Consultant shall monitor and verify the GCL and GCC overlapping procedures conform to the requirements of Section 02772 of the Technical Specifications. GCL and GCC panels shall be overlapped at a minimum of 6 inches along panel sides and a minimum of 12 inches along panel ends. Dry bentonite powder

shall be applied, at a minimum rate of one pound per lineal foot, around pipe penetrations or other perforations of GCL and GCC which may be required.

8.8 Repair

The CQC Consultant shall monitor the repair of any holes or tears in the GCL and GCC or the geotextile backing. Repairs shall be made by placing a patch made from the same type GCL and GCC over the damaged area. On slopes greater than 5 percent, the patch shall overlap the edges of the hole or tear by a minimum of 2 ft in all directions. On slopes, 5 percent or flatter, the patch shall overlap the edges of the hole or tear by a minimum of 1 ft in all directions. The patch shall be secured to the satisfaction of the Construction Manager to avoid shifting during backplacing with soil or covering with another geosynthetic.

TABLE 8-1:

GCL AND GCC CONFORMANCE TESTING REQUIREMENTS

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY[1]
Direct Shear[2]	ASTM D 5321	1 test per 100,000 ft^2
Hydraulic Conductivity	GRI GCL-2	1 test per 100,000 ft^2

Notes:

1. Testing shall be performed at a frequency of one per lot or at listed frequency, whichever is greater. A lot is defined by ASTM D 4354.

2. Each sample shall be tested for the following: (i) internal shear strength; (ii) interface shear strength of geosynthetic clay liner and the geomembrane liner and the geosynthetic clay cap and the geomembrane cap; and (iii) the interface shear strength of the geosynthetic clay liner and compacted clay liner and the geosynthetic clay cap and the compacted clay cap.

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9. GEOTEXTILES

9.1 Introduction

The CQC Consultant shall perform conformance testing and shall monitor the installation of geotextile filter, cushions, and separators as required by Section 02714 of the Technical Specifications and this CQA Plan. The testing used to evaluate the conformance of the geotextiles with the requirements of the Technical Specifications shall be performed by the CQC Consultant in accordance with the current versions of the ASTM or other applicable test procedure indicated in Tables 9-1 and 9-2.

9.2 Related Construction Drawings and Technical Specifications

The Subcontractor shall comply with Section 02714 of the Technical Specifications. This specification shall be referenced for specific details of the geotextile material properties, manufacturing quality control, and installation requirements of the geotextiles.

9.3 Transportation, Handling and Storage

The CQC Consultant shall monitor the transportation, handling, and storage of the geotextile on-site. The Construction Manager shall designate a geotextile storage location. During transportation, handling, and storage, the geotextile shall be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

Handling of the geotextiles rolls shall be performed in a competent manner such that damage does not occur to the geotextile nor to its protective wrapping. Rolls of geotextiles shall not be stacked upon one another to the extent that deformation of the core occurs or to the point where accessibility can cause damage in handling.

Furthermore, geotextile rolls shall be stacked in such a way that access for conformance sampling is possible. Protective wrappings shall be removed less than one hour prior to unrolling the geotextile. After unrolling, a geotextile shall not be exposed to ultraviolet light for more than 10 calendar days, unless otherwise specified by the Construction Manager.

Outdoor storage of rolls shall not exceed the manufacturers recommendations or longer than 6 months whichever is less. For storage periods longer than 6 months a temporary enclosure shall be placed over the rolls, or they shall be moved to an enclosed facility. The location of temporary field storage shall not be in areas where water can accumulate. The rolls shall be elevated off the ground to prevent water from ponding.

Upon delivery at the site, the Subcontractor, Geosynthetics Installer, and CQC Consultant shall conduct an inspection of the rolls for defects and damage. This inspection shall be conducted without unrolling the materials unless defects or damages are found or suspected. The CQC Consultant shall indicate to the Construction Manager:

- rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws; and

- rolls which include minor repairable flaws.

The CQC Consultant shall also monitor that equipment used to handle the geotextiles on-site is adequate and does not pose any risk of damage to the geotextiles when used properly.

9.4 Conformance Testing

9.4.1 Sampling Procedures

Samples shall be taken across the entire width of the roll and shall not include the first 3 feet. Unless otherwise specified, samples shall be 3 feet long by the roll width. The required minimum geotextile conformance sampling frequencies are provided in Tables 9-1 and 9-2. The CQC Consultant shall mark the machine direction on the samples with an arrow and affix a label, tag, or otherwise mark each sample with the following information:

- date sampled;
- project number;
- lot/batch number and roll number;
- conformance sample number; and
- CQC personnel identification.

The geotextile rolls which are sampled shall be immediately rewrapped in their protective coverings to the satisfaction of the Construction Manager.

9.4.2 Testing Procedure

Conformance testing of the geotextile materials delivered to the site will be conducted to ensure compliance with both the Technical Specifications and the manufacturer's list of minimum average roll values. As a minimum, the geotextile conformance test procedures listed in Tables 9-1 and 9-2 shall be performed by the Geosynthetics CQC laboratory.

- that excess tensile stress does not occur in the geotextile.

Soil backfilling or covering of the geotextile with another geosynthetic shall be completed within 10 days or as otherwise directed by the Construction Manager. On side slopes soil backfill shall be placed over the geotextile from the bottom of the slope upward.

9.4.3 Test Results

The CQC Consultant shall review all laboratory conformance test results and verify compliance of the test results with the specification shown in Appendix D prior to deployment of the geotextiles. Any nonconformance shall be reported to the Construction Manager.

9.4.4 Conformance Test Failure

In the case of failing test results, the Subcontractor may request that another sample from the failing roll be retested by the Geosynthetics CQC laboratory with the manufacturer's technical representative present during the test procedure. If the retest fails or if the option to retest is not exercised, then two isolation conformance samples shall be obtained by the CQC Consultant. These isolation samples shall be taken from rolls, which have been determined by correlation with the manufacturer's roll number, to have been manufactured prior to and after the failing roll. This method for choosing isolation rolls for testing should continue until passing tests are achieved. All rolls which fail numerically between the passing roll numbers shall be rejected by the Construction Manager. The CQC Consultant will verify that the Subcontractor has replaced all rejected rolls. The CQC Consultant shall document all actions taken in conjunction with geotextile conformance failures.

9.5 Placement

The CQC Consultant shall monitor the placement of all geotextiles to assure they are not damaged in any way, and the following conditions are met.

- On slopes, the geotextiles shall be securely anchored in the anchor trench and then rolled down the slope in such a manner as to continually keep the geotextile sheet in tension.

- In the presence of wind, all geotextiles shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with earth cover material.

- Trimming of the geotextiles shall be performed using only a upward cutting hook blade. Special care must be taken to protect other materials from damage which could be caused by the cutting of the geotextiles.

- The CQC Consultant shall monitor that the Geosynthetics Installer is taking necessary precautions to prevent damage to underlying layers during placement of the geotextile.

- During placement of geotextiles, care shall be taken not to entrap in the geotextile stones, excessive dust, or moisture that could damage the geomembrane, generate clogging of drains or filters, or hamper subsequent seaming.

- A visual examination of the geotextile shall be carried out over the entire surface, after installation, to ensure that no potentially harmful foreign objects, (e.g., stones, sharp objects, small tools, sandbags, etc.) are present.

9.6 Seams and Overlaps

All geotextiles shall be continuously sewn (i.e., spot sewing is not allowed). Geotextiles shall be overlapped 6 in. prior to seaming. No horizontal seams shall be allowed on side slopes that are steeper than 10 horizontal to 1 vertical (i.e. seams shall be along, not across, the slope), except as part of a patch.

Any sewing shall be done using polymeric thread with chemical and ultraviolet resistance properties equal to or exceeding those of the geotextile. The seams shall be sewn using a single row type "401" two-thread chainstich. The CQC Consultant shall

monitor the geotextile seaming procedures to verify that seams and overlaps are in accordance with Section 02714 of the Technical Specifications.

9.7 Repair

The CQC Consultant shall monitor that any holes or tears in the geotextile are repaired as follows:

- On slopes: A patch made from the same geotextile is double seamed into place (with each seam 1/4 in. to 3/4 in. apart and no closer than 1 in. from any edge) with a minimum 12-in. overlap. Should any tear exceed 50 percent of the width of the roll, that roll shall be removed from the slope and replaced.

- Non-slopes: A patch made from the same geotextile is sewn in place with a minimum of 12 in. overlap in all directions away from the repair area.

Care shall be taken to remove any soil or other material which may have penetrated the torn geotextile. The CQC Consultant shall observe all repairs and assure that any noncompliance with the above requirements is corrected.

9.8 Placement of Soil Materials

The CQC Consultant shall monitor the Subcontractor's placement of all soil materials located on top of a geotextile, to verify:

- that no damage occurs to the geotextile;

- that no shifting of the geotextile from its intended position occurs and underlying materials are not exposed or damaged; and

- that excess tensile stress does not occur in the geotextile.

Soil backfilling or covering of the geotextile with another geosynthetic shall be completed within 10 days or as otherwise directed by the Construction Manager. On side slopes soil backfill shall be placed over the geotextile from the bottom of the slope upward.

TABLE 9-1:

GEOTEXTILE FILTER CONFORMANCE TESTING REQUIREMENTS

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY1[4]
Mass per Unit Area	ASTM D5261	1 test per 100,000 ft^2
Grab Strength	ASTM D4632[1]	1 test per 100,000 ft^2
Trapezoidal Tear Strength	ASTM D4533[2]	1 test per 100,000 ft^2
Puncture Resistance	ASTM D4833[3]	1 test per 100,000 ft^2
Burst Strength	ASTM D3786	1 test per 100,000 ft^2
Apparent Opening Size	ASTM D4751	1 test per 100,000 ft^2
Permittivity	ASTM D4491	1 test per 100,000 ft^2

Notes:

1. Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
2. Minimum value measured in machine and cross machine direction.
3. Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with a flat tip centered within the ring clamp.
4. Testing shall be performed at a frequency of one per lot or at listed frequency, whichever is greater. A lot is defined by ASTM 4354.

TABLE 9-2:

GEOTEXTILE CUSHIONS AND SEPARATOR CONFORMANCE TESTING REQUIREMENTS

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY[4]
Mass per Unit Area	ASTM D5261	1 test per 100,000 ft^2
Grab Strength	ASTM D4632[1]	1 test per 100,000 ft^2
Trapezoidal Tear Strength	ASTM D4533[2]	1 test per 100,000 ft^2
Puncture Resistance	ASTM D4833[3]	1 test per 100,000 ft^2
Burst Strength	ASTM D3786	1 test per 100,000 ft^2

NOTES:

1. Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
2. Minimum value measured in machine and cross machine direction.
3. Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with a flat tip centered within the ring clamp.
4. Testing shall be performed at a frequency of one per lot or at listed frequency, whichever is greater. A lot is defined by ASTM 4354.

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10. HDPE MANHOLES, PIPES, FITTINGS AND VALVES

10.1 Introduction

The CQC Consultant shall monitor the installation of ancillary materials such as manholes, pipes, fittings, and valves for leachate collection and transmission as required by Section 02605 of the Technical Specifications and this CQA Plan.

10.2 Butt-Fusion Welding Process

The CQC Consultant shall monitor the assembling of lengths of HDPE pipe into suitable installation lengths by the butt-fusion process. Butt-fusion means the butt-joining of the pipe by softening the aligned faces of the pipe ends in a suitable apparatus and pressing them together under controlled pressure. Butt-fusion welding of the HDPE pipes and fittings shall be performed by the Subcontractor in accordance with the pipe manufacturer's recommendations as to equipment and technique.

10.3 Transportation, Handling and Storage

The pipe is to be placed on wooden pallets and bundled together with plastic straps for bulk handling and shipment. The packing shall be such that either fork lifts or cranes equipped with slings can be used for safety handling. The pipe shall be segregated by wall thickness and diameter.

The CQC Consultant shall monitor the offloading of the palletized pipe to assure that handling of the pallets is done in a competent manner and that the pallets are not placed in areas where water can accumulate. The pallets shall not be stacked more then three high or in such a manner that could cause damage to the pipe. Furthermore, the pipe shall be stacked in such a manner that access for conformance sampling is possible. Outdoor storage should be no longer than 12 months. For outdoor storage

periods longer than 12 months a temporary covering shall be placed over the pipes. or they shall be moved to within an enclosed facility.

10.4 Installation

Care will be taken during installation of the HDPE manholes and pipe such that they will not be cut, kinked, or otherwise damaged. Ropes, fabric, or rubber-protected slings and straps shall be used by the Subcontractor when installing manholes and pipes. The use of chains. cables. or hooks inserted into the pipe ends shall not be approved by the Construction Manager.

The Subcontractor shall install the manholes, pipe fittings, and values in such a manner that the materials are not damaged. Slings for handling the pipeline shall not be positioned at butt-fused joints. Sections of the pipes with deep cuts and/or gouges shall be removed and the ends of the pipeline rejoined. Care shall be exercised when lowering pipe into the trench to prevent damage or twisting of the pipe.

11. MECHANICAL AND ELECTRICAL

11.1 Introduction

The CQC Consultant shall monitor the materials used in and installation of all mechanical and electrical systems to assure compliance with Division 15 and Division 16 of the Technical Specifications. The mechanical and electrical systems include, but are not limited to, the following:

- permanent lift station electrically actuated isolation valve, lift station control panel, associated instrumentation, alarm light and siren, and all other work;
- leak detection manholes control panels and associated instrumentation, alarm lights, and all other work;
- leachate collection manholes manual valves and all other work;
- decontamination facility pumps, and electrical and potable water service;
- overhead power distribution system, power wiring, including power circuit connections for pump motors, and equipment mounting boards; and
- temporary support facilities electric, water, and sanitary sewer services.

11.2 Related Construction Drawings and Technical Specifications

The mechanical work performed by the Subcontractor shall comply with Division 15 of the Technical Specifications. These specifications shall be referenced for specific details of the mechanical equipment requirements and installation. The electrical work performed by the Subcontractor shall comply with Construction Drawings and Technical Specifications. These specifications shall be referenced for specific details of the electrical requirements and installation.

11.3 Codes, Rules, Inspections, and Workmanship

The CQC Consultant shall monitor the work of the Subcontractor in the installation of all mechanical and electrical appurtenances in accordance with national codes and other regulations or authorities having jurisdiction over the work. The CQC Consultant shall observe and document construction acceptance testing procedures performed by the Subcontractor. The CQC Consultant shall also observe and document operational all construction acceptance testing procedures performed by the Subcontractor.

11.4 Record Drawings

The CQC Consultant shall monitor the maintenance by the Subcontractor of a set of prints on which the actual installation of all mechanical and electrical work shall be accurately shown, indicating any variation from Construction Drawings. Changes in layout or circuitry shall be clearly and completely indicated as the work progresses. These progress prints shall be inspected by the Resident Engineer and Construction Manager and used to determine the progress of mechanical and electrical work.

At the completion each phase of the work, the CQC Consultant shall obtain from the Subcontractor a set of record drawings of the work to include marked-up prints showing the dimensioned location of all underground systems.

12. CONCRETE

12.1 Introduction

This CQC Consultant shall monitor the construction and perform conformance testing of all concrete materials and finished products to assure compliance with Construction Drawings and Technical Specifications.

12.2 Inspections

The CQC Consultant shall monitor concrete workmanship to assure that the Subcontractor does not place concrete until foundations, forms, reinforcing steel, pipes, conduits, sleeves, anchors, hangers, inserts, and other work required to be built into concrete has been inspected and approved by the Construction Manager. The Subcontractor is required to notify the Construction Manager and CQC Consultant at least 24 hours in advance of concrete placement activities and scheduling the inspections activities described above.

12.3 Field Quality Control Testing

Concrete conformance testing shall be the responsibility of the CQC Consultant. The concrete test program shall meet the following requirements.

- Concrete samples will be obtained by the CQC Consultant at a frequency of one set of standard cylindrical test specimens for the first 5 cubic yards and every 25 cubic yards of concrete or any portion of thereafter for each structure. For each work shift, when concrete is delivered, at least one set of specimens will be made. A set of test specimens will consist of at least four standard cylinders. Each set of test specimens will be tested for 7-day and 28-day compressive strength.

- Compressive strengths shall be determined from the standard test specimens taken according to ASTM C 31 and ASTM C 172, and cured and tested in accordance with ASTM C 39. Core drilling, if required, and testing will be in accordance with ASTM C 42.

- Slump and air content shall be determined with no less frequency than that of casting strength specimen sets. Air content and slump shall be determined in accordance with ASTM C 231 and ASTM C 143, respectively.

The CQC Consultant shall be responsible for reporting all test results to the Subcontractor and the Construction Manager. Materials determined by the Construction Manager to fail the requirements of the Construction Drawings and Technical Specifications shall be rejected.

13.4 Subbase Layer

The CQC Consultant shall monitor the subbase aggregate to ensure it is constructed to the thickness, grades, and limits shown on the construction drawings. The CQC Consultant shall monitor the test section required in Section 02230 of the Technical Specifications.

13.5 Base Layer

The CQC Consultant shall monitor the subbase aggregate to ensure it is constructed to the thickness, grades, and limits shown on the Construction Drawings. The CQC Consultant shall monitor the test section required in Section 02230 of the Technical Specifications.

13.6 Quality Control Testing

Quality control testing of the materials used in construction of the roads and paved surfaces shall be the responsibility of the CQC Consultant. The frequency of CQC testing for the subbase aggregate and base aggregate materials is as follows:

- particle size analysis (ASTM C136) at a frequency of one test per 5,000 yd^3; and

- density and moisture (ASTM D 2922 and ASTM D 3017) at a frequency of one test per 100 lineal feet per lift.

Requirements for in-situ density of subbase and base aggregates shall be defined during the compaction of a test strip. The test strip for subbase aggregate shall be in accordance with the requirements of Item 310.03 of the Ohio DOT Specifications. The base aggregate shall be compacted in accordance with the requirements of Item 304.04 of the Ohio DOT Specifications.

13.7 Repairs

If a defective area is discovered, the CQC Consultant will evaluate the extent and nature of the defect. After this determination the Subcontractor shall correct the deficiency to the satisfaction of the Construction Manager. The Subcontractor shall not perform additional work in the area until the Construction Manager approves the correction of the defect. In the event of damage, the Subcontractor shall immediately make repairs and replacements as necessary to the satisfaction of the Construction Manager.

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14. GENERAL SITE WORK

14.1 Introduction

The CQC Consultant shall monitor the activities which are to be performed for various general site work items including, but not limited to rip rap, erosion and sediment control, culverts, chain link fences and gates, and vegetation for compliance with Construction Drawings and Technical Specifications.

14.2 Conformance Testing

Conformance testing of materials to ensure compliance with the Construction Drawings and Technical Specifications shall be performed by the CQC Consultant at the discretion of the Construction Manager. If nonconformances or other deficiencies are found by the CQC Consultant in the Subcontractors materials or completed work, the Subcontractor will be required to repair or replace the deficiency at not cost. Any noncompliant items shall be reported to the Construction Manager.

APPENDIX A

EXAMPLES OF CQC FORMS

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

REPAIR SUMMARY LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ YEAR: _____

PRIMARY: ☐ SECONDARY: ☐ OTHER: ☐ _____ CONTRACTOR: _____

DATE (day/mo)	REPAIR LOCATION		REPAIR NO. AND CODE (1)	REPAIR TYPE (2)	REPAIR			WELDER ID		QA ID	NON-DESTRUCTIVE TESTING				
	SEAM OR PANEL	MAPPING (DIST FROM 0-FT OR EDGE)			LENGTH (ft)	WIDTH (ft)	DIA (ft)	MACH NO.	OPER ID		DATE (day/mo)	OPER ID	PASS/ FAIL	ACTION	QA ID
(15)															

NOTES: (1) REPAIR NO.: REPAIRS CAN BE NUMBERED SEQUENTIALLY, IF NECESSARY.
(1) REPAIR CODES: P = PATCH, C = CAP, S= ANCHOR TRENCH EXTENSION (SKIRT), DS = DESTRUCTIVE SAMPLE, G = GRIND & WELD, T = TOPPING ALONG FUSION SEAM, R = RECONSTRUCTION
(2) REPAIR TYPES: E = EXTRUSION, F = FUSION

GeoSyntec Consultants

FLUOR DANIEL FERNALD

DESTRUCTIVE TEST LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ YEAR: _____

CONTRACTOR: _____ TEST REQUIREMENTS: _____

PRIMARY: ☐ SECONDARY: ☐ RE-TEST: ☐ OTHER: ☐ _____

DISTRIBUTION: LABORATORY: ☐ ARCHIVE: ☐ INSTALLER: ☐ OTHER: ☐

SAMPLE DATA					FIELD DATA					LABORATORY DATA						
D.S. NO.	SEAM/ LOCATION	MACH NO.	OPER ID	DATE SAMPLED/ SHIPPED (day/mo)	AVG PEEL (PPI/PSI) INSIDE	AVG PEEL (PPI/PSI) OUTSIDE	AVG SHEAR (PPI/PSI)	PASS/ FAIL	QA ID	DATE OF RESULTS (day/mo)	AVG PEEL (PPI/PSI) INSIDE	AVG PEEL (PPI/PSI) OUTSIDE	AVG SHEAR (PPI/PSI)	PASS/ FAIL	RE-TEST	QA ID

(15)

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

SEAM AND PANEL REPAIR LOCATION LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: ____ day ____ month ____ year

CONTRACTOR: _____

PRIMARY: ☐ SECONDARY: ☐ OTHER: ☐ PRODUCT TYPE: _____

NORTH

NOTE:
SEE OTHER SIDE FOR SYMBOLS

QA ID: _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

SEAM SUMMARY LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: ______ YEAR: ______

CONTRACTOR: ______

PRIMARY: ☐ SECONDARY: ☐ OTHER: ☐ ______ PRODUCT TYPE: ______

PRODUCTION SEAMING						NONDESTRUCTIVE TESTING						
DATE (day/mo)	SEAM NO.	MACHINE NO.	OPERATOR ID	ACTUAL SEAM LENGTH (ft)	QA ID	DISTANCE (ft)	AIR PRESSURE (__4__ psi for 5 min.)	VACUUM BOX (______ sec.)	OPERATOR ID	PASS/ FAIL	ACTION	QA ID
			TOTAL (1)									

NOTE: (1) SEAM LENGTH: THIS PAGE ______ (ft) ACCUMULATED ______ (ft)

GeoSyntec Consultants

FLUOR DANIEL FERNALD

TRIAL SEAM LOG - FUSION

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: YEAR:

CONTRACTOR: TENSIOMETER DESCRIPTION:

TRIAL SEAM NO.	DATE (day/mo)	TIME	MACHINE NO.	OPER ID	(1) MATERIAL DESCRIPTION	FUSION		TEST RESULTS				RETEST NO.	QA ID
						WEDGE (SET/°C/°F)	MEASURED SPEED (ft/min)	PEEL (ppi/psi) INSIDE	PEEL (ppi/psi) OUTSIDE	SHEAR (ppi/psi)	PASS/ FAIL		

NOTE: (1) MATERIAL DESCRIPTION REFERS TO EITHER SMOOTH/SMOOTH (S/S); SMOOTH/TEXTURED (S/T); OR TEXTURED/TEXTURED (T/T).

GeoSyntec Consultants

FLUOR DANIEL FERNALD

TRIAL SEAM LOG - EXTRUSION

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: YEAR:

CONTRACTOR: TENSIOMETER DESCRIPTION:

TRIAL SEAM NO.	DATE (day/mo)	TIME	MACHINE NO.	OPER ID	(1) MATERIAL DESCRIPTION	EXTRUSION		TEST RESULTS				RE-TEST NO.	QA ID
						PREHEAT (SET/°C/°F)	BARREL (°C/°F)	PEEL (ppi/psi)	SHEAR (ppi/psi)	PASS	FAIL		

NOTE: (1) MATERIAL DESCRIPTION REFERS TO EITHER SMOOTH/SMOOTH (S/S); SMOOTH/TEXTURED (S/T); OR TEXTURED/TEXTURED (T/T).

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

PANEL PLACEMENT LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ YEAR: _____

PRIMARY: ☐ SECONDARY: ☐ OTHER: ☐ PRODUCT TYPE: _____

PANEL NO.	BATCH / ROLL NO.	DATE (day/mo)	TIME	PLACEMENT LOCATION COMMENTS	APPROX WIDTH (ft)	APPROX LENGTH (ft)	QA ID
				TOTALS:(1)			

NOTE: (1) APPROXIMATE AREA: THIS PAGE: _____ (ft^2) ACCUMULATED: _____ (ft^2)

NOTES: _____

CERTIFICATE OF ACCEPTANCE
SUBGRADE SURFACE

INSTALLER	PROJECT
NAME: _____	NAME: _____
ADDRESS: _____	_____
_____	LOCATION: _____
_____	_____
INSTALLER AUTHORIZED REPRESENTATIVE: _____	_____
	OWNER: _____

I, The undersigned, duly authorized representive of _____ do hereby accept the surface on which the geosynthetics will be installed and shall be responsible for maintaining the suitability of this surface, in accordance with the project specifications. (i.e., The contractor shall not install the geosynthetics until the subgrade surface is acceptable. Installation of the geosynthetics will be considered acceptance the subgrade.)

PRIMARY: ☐ SECONDARY: ☐ OTHER: ☐ _____

DATE	PANEL NOS.	SIGNATURE

GeoSyntec Consultants

FLUOR DANIEL FERNALD

GEOCOMPOSITE TEST REQUEST FORM NO. _____

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ YEAR: _____

SAMPLED: _____ day _____ mo SAMPLER ID: _____ SHIPPED: _____ day _____ mo SHIPPER ID: _____ RECEIVED: _____ day _____ mo LAB ID: _____

MANUFACTURED BY: _____ SAMPLE SHIPPED VIA: _____

SITE CONTACT: _____ SITE PHONE: _____ SITE FAX: _____

SAMPLE NO. GDL-	BATCH NO./ ROLL NO.	GEOCOMPOSITE				GEONET				GEOTEXTILE			
		PEEL STRENGTH ASTM D413 F904	MASS PER UNIT AREA ASTM D3776	THICKNESS ASTM D374C D5199	TRANS-MISSIVITY ASTM 4716	CARBON BLACK CONTENT ASTM D1603	MASS PER AREA ASTM D3776	CARBON DISPERSION ASTM D3015	THICKNESS ASTM D5199	MASS PER UNIT AREA ASTM D3776	TENSILE ASTM D638	APPARENT OPENING SIZE ASTM D4751	PERMITTIVITY ASTM D4491

DOUBLE SIDED OR SINGLE SIDED MATERIAL

COMMENTS/SPECIAL INSTRUCTIONS/DISTRIBUTION: Strikeout nonapplicable items

GeoSyntec Consultants

FLUOR DANIEL FERNALD

GEOTEXTILE TEST SUMMARY REQUEST FORM NO. _____

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ YEAR: _____

SAMPLED: _____ day _____ mo SAMPLER ID: _____ SHIPPED: _____ day _____ mo SHIPPER ID: _____ RECEIVED: _____ day _____ mo LAB ID: _____

MANUFACTURED BY: _____ SAMPLE SHIPPED VIA: _____

SITE CONTACT: _____ SITE PHONE: _____ SITE FAX: _____

SAMPLE NO. GT-	ROLL NO./ BATCH NO.	MASS/ AREA ASTM D3776 D5261	THICKNESS ASTM D1777 D5199	GRAB TENSILE ASTM D4632	TRAP TEAR ASTM D4533	MULLEN BURST ASTM D3786	AOS ASTM D4491	PERMITIVITY ASTM D4491	WIDE-WIDTH TENSILE ASTM D4595	WIDE-STRIP SEAM ASTM D4884	STRIP TENSILE ASTM D1682 D5035	PUNCTURE ASTM D4833	OTHER

WOVEN OR NONWOVEN MATERIAL

COMMENTS/SPECIAL INSTRUCTIONS/DISTRIBUTION: Strikeout nonapplicable items

GeoSyntec Consultants

FLUOR DANIEL FERNALD

GEONET TEST REQUEST FORM NO. _____

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ YEAR: _____

SAMPLED: _____ day _____ mo SAMPLER ID: _____ SHIPPED: _____ day _____ mo SHIPPER ID: _____ RECEIVED: _____ day _____ mo LAB ID: _____

MANUFACTURED BY: _____ SAMPLE SHIPPED VIA: _____

SITE CONTACT: _____ SITE PHONE: _____ SITE FAX: _____

SAMPLE NO. GN-	BATCH NO./ ROLL NO.	MASS PER AREA ASTM D3776	THICKNESS ASTM D374C/ D5199	SPG DENSITY ASTM D792	WIDE-WIDTH TENSILE ASTM D4533	CARBON CONTENT ASTM D1603	CARBON DISPERSION ASTM D5596	MELT INDEX ASTM D1238	CBR GRI-GN1	COM-PRESSION GRI-GN1	TRANS-MISSIVITY ASTM D4716	TENSILE STRENGTH ASTM D5035	OTHER

GEONET OR GEONET COMPOSITE MATERIAL

COMMENTS/SPECIAL INSTRUCTIONS/DISTRIBUTION: Strikeout nonapplicable items

GeoSyntec Consultants

FLUOR DANIEL FERNALD

GEOGRID TEST REQUEST FORM NO. _____

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ YEAR: _____

SAMPLED: _____ day _____ mo SAMPLER ID: _____ SHIPPED: _____ day _____ mo SHIPPER ID: _____ RECEIVED: _____ day _____ mo LAB ID: _____

MANUFACTURED BY: _____

SITE CONTACT: _____ SITE PHONE: _____ SITE FAX: _____

SAMPLE NO. GG-	BATCH NO./ ROLL NO.	SPG DENSITY ASTM D792	RIB THICK ASTM D1777	PUNCT THICKNESS (JUNCTION) D1777	RIB TENSILE GRI-GG1	JUNCTION STRENGTH GRI-GG1	MASS PER AREA ASTM D3776	MELT INDEX ASTM D1238	APERTURE SIZE	CARBON CONTENT ASTM D1603	CARBON DISPERSION ASTM D5596	WIDE-WIDTH TENSILE ASTM D4595	PERCENT OPEN AREA	OTHER

UNIAXIAL OR BIAXIAL MATERIAL

COMMENTS/SPECIAL INSTRUCTIONS/DISTRIBUTION: Strikeout nonapplicable items

GeoSyntec Consultants
Materials Testing Laboratory

FLUOR DANIEL FERNALD

GEOMEMBRANE TEST REQUEST FORM NO. _____

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ YEAR: _____

SAMPLED: _____ day _____ mo SAMPLER ID: _____ SHIPPED: _____ day _____ mo SHIPPER ID: _____ RECEIVED: _____ day _____ mo LAB ID: _____

MANUFACTURED BY: _____

SITE CONTACT: _____ SITE PHONE: _____ SITE FAX: _____

SAMPLE NO. GM-	BATCH NO./ ROLL NO.	ANALYSIS REQUIRED (STRIKE OUT NONAPPLICABLE TESTS)									
		TENSILE ASTM D638	MELT INDEX ASTM D1238	DENSITY ASTM D792	THICKNESS ASTM D5199/D751 D3342/D1593	CARBON BLACK ASTM D1603	PERCENT CARBON BLACK ASTM D1603	TEAR RESISTANCE ASTM D1004	PUNCTURE RESISTANCE FTMS 101C METHOD 2065	ESCR/NCTL SINGLE POINT ASTM D1693 D5397	OTHER

SMOOTH OR TEXTURED MATERIAL (CIRCLE ONE)

COMMENTS/SPECIAL INSTRUCTIONS:

GeoSyntec Consultants

FLUOR DANIEL FERNALD

GEOSYNTHETIC CLAY LINER TEST REQUEST FORM NO. _____

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ YEAR: _____

SAMPLED: _____ day _____ mo SAMPLER ID: _____ SHIPPED: _____ day _____ mo SHIPPER ID: _____ RECEIVED: _____ day _____ mo LAB ID: _____

MANUFACTURED BY: _____ SAMPLE SHIPPED VIA: _____

SITE CONTACT: _____ SITE PHONE: _____ SITE FAX: _____

SAMPLE NO. GCL-	BATCH NO./ ROLL NO.	MASS PER UNIT WEIGHT ASTM D3776	MOISTURE CONTENT ASTM D2216	FREE SWELL A.P.I. TEST NO. 1010	HYDRAULIC CONDUCTIVITY ASTM D5084	THICKNESS ASTM D5199	OTHER

REINFORCED OR NONREINFORCED MATERIAL

COMMENTS/SPECIAL INSTRUCTIONS/DISTRIBUTION: Strikeout nonapplicable items

GeoSyntec Consultants

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ YEAR: _____

PRODUCT TYPE: _____ MANUFACTURER: _____

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO.	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID

AVG. ROLL WIDTH: _____ AVG. ROLL LENGTH: _____

NUMBER OF ROLLS ABOVE: _____ ACCUMULATIVE NUMBER OF ROLLS: _____

CUMULATIVE AREA: _____ NO. OF CONFORMANCE TESTS (page/total): 1/

GeoSyntec Consultants

FLUOR DANIEL FERNALD

LABORATORY TEST SUMMARY REQUEST FORM NO. _____

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

MATERIAL TYPE: _____ QA ID: _____

NOTE: Separate forms are required for each material type and source. Strike out nonapplicable tests.

SITE SAMPLE NO.	LAB SAMPLE NO.	MOISTURE CONTENT ASTM D 2216/ D 4643 (%)	GRAIN SIZE			ATTERBERG LIMITS ASTM D 4318			SP. GR. ASTM D 854	SOIL CLASS. ASTM D 2487	LOI	CARBO CONT.	COMPACTION ASTM D 698 (or) ASTM D 1557		PERMEABILITY ASTM D 2434[1] (or) ASTM D 5084[2]			PASS/ FAIL	ACUMUL. QUANT. PLACED (APPROX)
			PASSING NO. 200 SIEVE ASTM D 1140 (%)	ASTM D 422 SIEVE	ASTM D 422 HYDR.	LL (%)	PL (%)	PI			ASTM C311 (%)	ASTM D3042 (%)	MAX. DRY UNIT WT. (pcf)	OPT. MOIST. CONT. (%)	DRY UNIT WT. (pcf)	MOIST. CONT. ASTM D 2216 (%)	HYDRAULIC COND'VITY (cm/sec)		(yd^3)

COMMENTS: _____

NOTES: (1) HYDRAULIC CONDUCTIVITY DETERMINED AT A HYDRAULIC GRADIENT OF ____.

(2) HYDRAULIC CONDUCTIVITY DETERMINED AT AN EFFECTIVE CONFINING STRESS OF ____.

GeoSyntec Consultants

FLUOR DANIEL FERNALD

SUMMARY OF FIELD DENSITY TESTS

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

MATERIAL TYPE: _____ QA ID: _____

DATE OF TEST (day/mo)	TEST NO.	TEST LOCATION	LAB RESULTS			TYPE OF TEST		FIELD TEST RESULTS				PERCENT COMPACT (%)	PASS	FAIL	RETEST NO.
			SAMPLE NO.	O.M.C. (%)	MAX UNIT WT (pcf)	ASTM D 2922	ASTM D 1556	DEPTH/ ELEV (ft)	FMC (%)	DRY UNIT WT (pcf)	WET UNIT WT (pcf)				

COMMENTS: _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

FIELD NUCLEAR MOISTURE/DENSITY TEST LOG (ASTM D 3017 AND ASTM D 2922)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

SPECIFICATION REQUIREMENTS

SOURCE: _____ MATERIAL TYPE: (CIRCLE ONE) FILL / SUBGRADE / SUBBASE / CLAY / OTHER: _____ LIFT THICKNESS (LOOSE/COMPACTED): _____

% COMPACTION: _____ MOISTURE RANGE: _____ ASTM D 698: A B C / ASTM D 1557: A B C (CIRCLE ONE) _____

NUCLEAR GAUGE TYPE: _____ NUCLEAR GAUGE SERIAL NO. _____ COR. FACTOR: _____ QA ID: _____

TEST NO.	TEST LOCATION	PROBE DEPTH/ LIFT NO.	LAB RESULTS			FIELD TEST RESULTS						RETEST NO.	RETEST	
			SAMPLE NO.	OMC (%)	MAX DRY UNIT WT (PCF)	FMC (%)	WET UNIT WT (PCF)	DRY UNIT WT (PCF)	PERCENT COMPACT (%)	PASS	FAIL		PASS	FAIL

COMMENTS:

GeoSyntec Consultants FILE NO.: 2-20-FNM CHECKED: _____ SHEET NO. ____ ____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

NUCLEAR GAUGE STANDARD COUNT LOG (ASTM D 2922 & ASTM D 3017)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ YEAR: _____

NUCLEAR GAUGE MODEL: _____ SERIAL NO.: _____

DATE ARRIVED ON SITE: _____ DATE DEPART SITE: _____

DATE OF MOST RECENT LEAK TEST: _____

DATE (day/mo)	MOISTURE COUNT	DENSITY COUNT	PASS/ FAIL	QA ID

DATE (day/mo)	MOISTURE COUNT	DENSITY COUNT	PASS/ FAIL	QA ID

NOTE: A COPY OF THIS FORM SHOULD ACCOMPANY GAUGE WHEN SHIPPED FROM SITE.

GeoSyntec Consultants

FLUOR DANIEL FERNALD

DETERMINATION OF DENSITY (DRIVE CYLINDER) (ASTM D 2937)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

SOURCE: _____ QA ID: _____

SPECIFICATION REQUIREMENTS:

MATERIAL TYPE: (CIRLCLE ONE) FILL / SUBGRADE / SUBBASE / CLAY / OTHER: _____

% COMPACTION: _____ MOISTURE CONTENT RANGE: _____

TEST LOCATION: _____ TEST NO.: _____

FIELD TEST DATA – ASTM D 2937 QA ID: _____

A	CYLINDER NO. _____ VOLUME[1] (cf)		D	WEIGHT OF WET SAMPLE = B–C (lbs)	
B	WEIGHT OF SAMPLE & CYLINDER (lbs)		E	WET UNIT WEIGHT = D/A (lbs)	
C	WEIGHT OF CYLINDER (lbs)		F	DRY UNIT WEIGHT = E/[1+(T/100)] (pcf)	

NOTE: CYLINDER VOLUME IS OBTAINED BY MEASURING THE HEIGHT AND DIAMETER, OF FOUR EQUALLY SPACED POINTS, TO 0.01 in AND CALCULATING VOLUME USING AVERAGE HEIGHT AND DIAMETER.

FIELD MOISTURE CONTENT – ASTM D 2216 QA ID: _____

O	WT. OF TARE NO. _____ (grams)		R	WT. OF WATER = P–Q (grams)	
P	WT. OF WET SOIL & TARE (grams)		S	WT. OF DRY SOIL = Q–O (grams)	
Q	WT. OF DRY SOIL & TARE (grams)		T	MOISTURE CONTENT = (R/S)X100 (%)	

PROCTOR TEST DATA _____ MAXIMUM DRY UNIT WT. (pcf) _____ OPTIMUM MOISTURE CONTENT (%) _____

COMPARISON WITH NUCLEAR GAUGE – ASTM D 2922 AND D 3017 QA ID: _____

TEST NO.			U	MOISTURE CONTENT (%)	
WET UNIT WT. (pcf)			V	DRY UNIT WT. (pcf)	
DELTA DRY UNIT WT. = F – V				DELTA MOISTURE CONTENT = T – U	

COMMENTS:

GeoSyntec Consultants

FLUOR DANIEL FERNALD

FIELD SAND CONE DENSITY TEST (ASTM D 1556)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

SOURCE: _____

SPECIFICATION REQUIREMENTS:

GeoSyntec Consultants

FLUOR DANIEL FERNALD

PARTICLE SIZE DISTRIBUTION AND SOIL CLASSIFICATION TEST RESULTS (ASTM D 422 & ASTM D 2487)

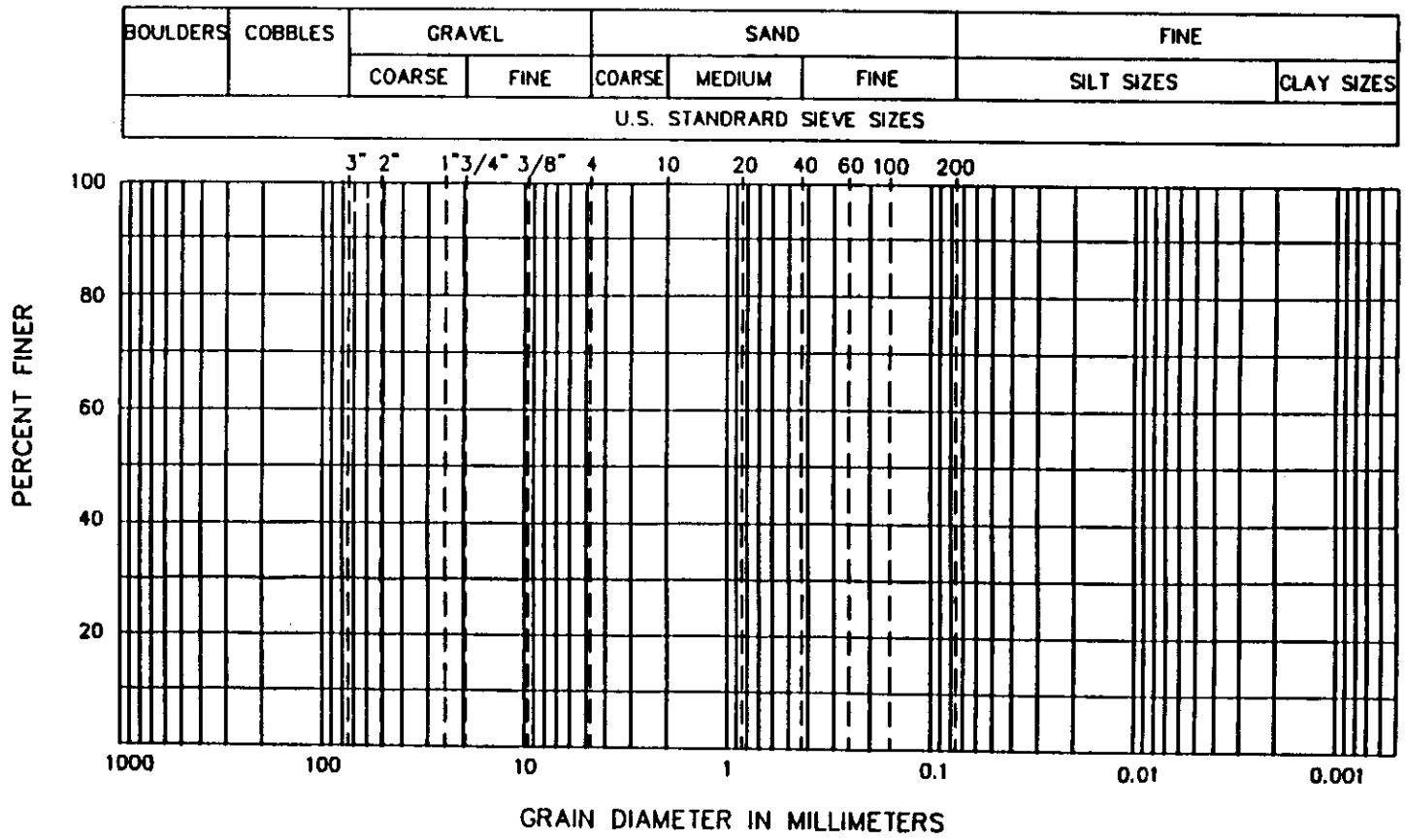
PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

MATERIAL TYPE: _____ SAMPLE NO.: _____ QA ID: _____

CURVE COEFFICIENTS: (C_u) ..... (C_c) .....



ATTERBERG LIMITS

(LL) .....

(PL) .....

(PI) .....

SIEVE RESULTS

SIEVE SIZE	% FINER
3-in.	
2-in.	
1 1/2-in.	
1-in.	
3/4-in.	
1/2-in.	
3/8-in.	
NO. 4	
NO. 10	
NO. 20	
NO. 40	
NO. 60	
NO. 100	
NO. 200	

HYDROMETER RESULTS

PARTICLE DIA.	% FINER

SOIL CLAS ATION (ASTM D 2487): _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

PARTICLE SIZE ANALYSIS HYDROMETER METHOD (ASTM D 422)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: ____ day ____ month ____ year

MATERIAL TYPE: _____ SAMPLE NO.: _____

HYDROMETER ANALYSIS

QA ID: _____

TARE NO.: _____ PERCENT PASSING NO. 200 SIEVE = _____

DISPERSING AGENT: _____ AMOUNT: 125 ml from 40 grams/liter batch

ORIGINAL WEIGHT OF SOIL: _____ MOISTURE CONTENT: _____

DATE (day/mo)	TIME OF READING	ELAPSED TIME (MIN)	OBSERVED TEMP. (°F/°C)	TOTAL CORRECTION	ORIGINAL HYD. READING	CORRECTED HYD. READING	MEAN PARTICLE DIAM., From Chart (mm)	% FINER	PROJECT SPECIFICATIONS

GeoSyntec Consultants

FLUOR DANIEL FERNALD

PARTICLE SIZE ANALYSIS MECHANICAL SIEVE METHOD (ASTM D 422)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: ____ day ____ month ____ year

MATERIAL TYPE: _____ SAMPLE NO.: _____

SOIL SAMPLE SIZE

APPROXIMATE MINIMUM WT. OF SAMPLE (PASSING NO. 10 SIEVE) (grams)	SAND	FINE GRAIN
	115	65

	BEFORE WASH	AFTER WASH
TARE NO.		
WT. OF DRY SAMPLE PLUS TARE (grams)		
WT. OF TARE (grams)		
WT. OF DRY SAMPLE (grams)		

SIEVE ANALYSIS

QA ID: _____

SIEVE NO.	DIAMETER (mm)	WT. RETAINED (grams)	% RETAINED	% FINER	PROJE SPECIFICA.

%FINER = 100 - Σ% RETAINED

GeoSyntec Consultants

FLUOR DANIEL FERNALD

ATTERBERG LIMITS TEST (ASTM D 4318)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

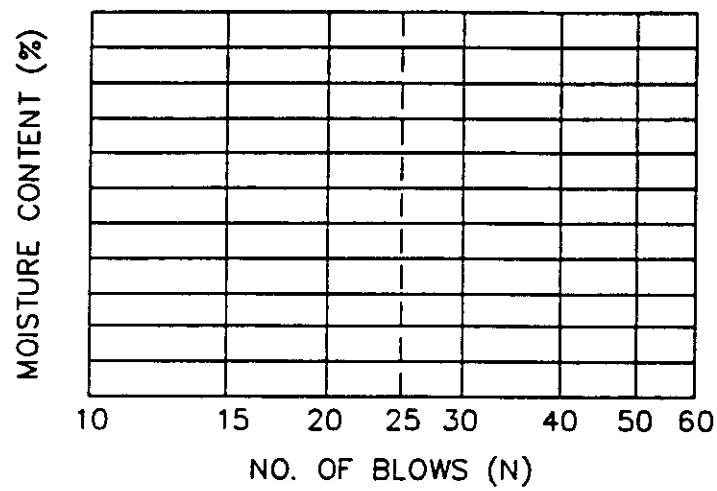
MATERIAL TYPE: _____ SAMPLE NO.: _____

LIQUID LIMIT DETERMINATION

QA ID: _____

	TARE NO.					
A	WT. OF TARE	(grams)				
B	WT. OF WET SOIL & TARE	(grams)				
C	WT. OF DRY SOIL & TARE	(grams)				
D	WT. OF WATER = B-C	(grams)				
E	WT. OF DRY SOIL = C-A	(grams)				
F	MOISTURE CONTENT = (D/E)X100	(%)				
N	NUMBER OF BLOWS					

DRYING TARE NO.



CURING TARE NO.

PLASTIC LIMIT DETERMINATION

QA ID: _____

	TARE NO.					
A	WT. OF TARE	(grams)				
B	WT. OF WET SOIL & TARE	(grams)				
C	WT. OF DRY SOIL & TARE	(grams)				
D	WT. OF WATER = B-C	(grams)				
E	WT. OF DRY SOIL = C-A	(grams)				
F	MOISTURE CONTENT = (D/E)X100	(%)				

LIQUID LIMIT (LL) = _____ PLASTIC LIMIT (PL) = _____ PLASTICITY INDEX (PI) = _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

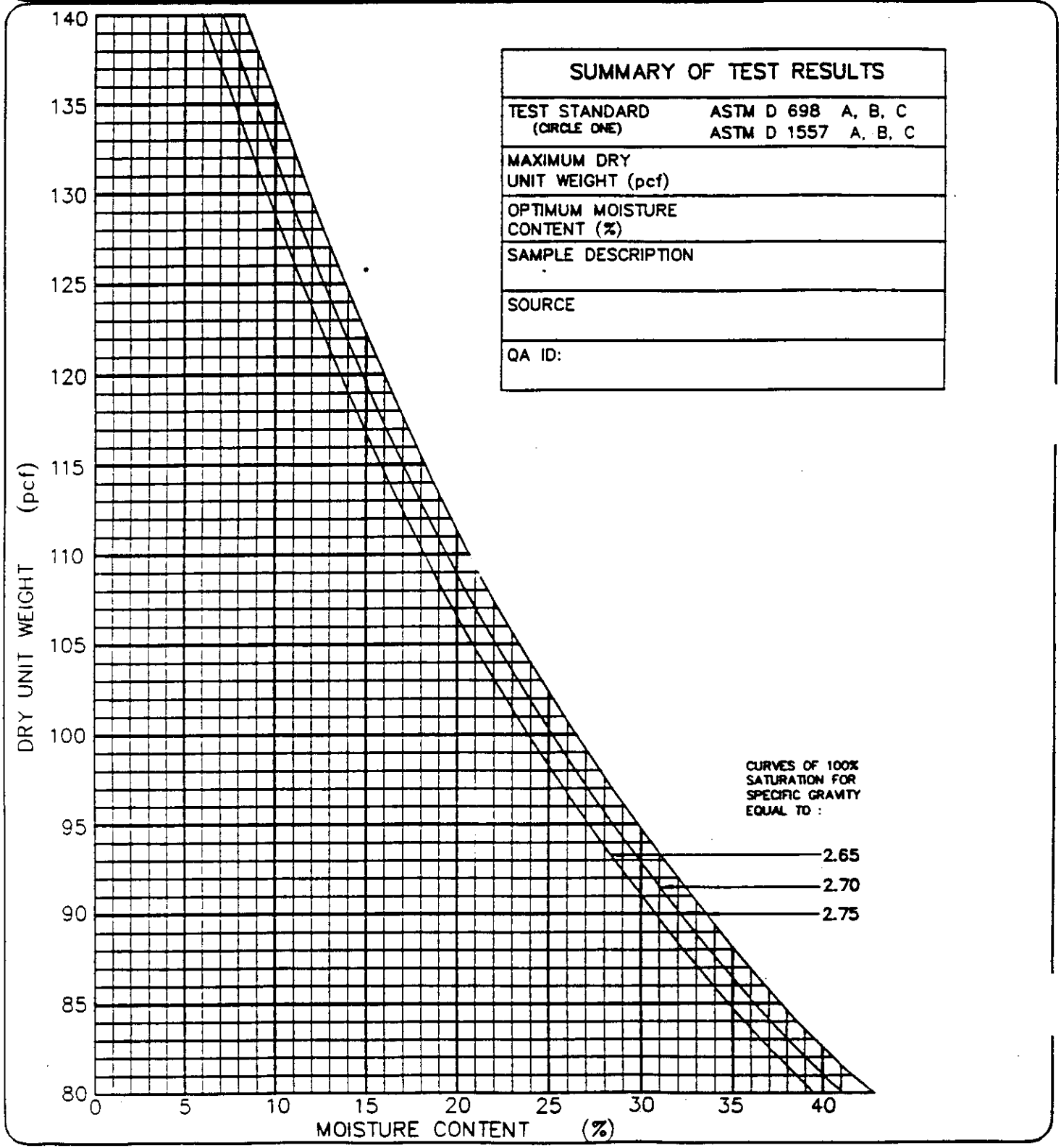
MOISTURE-DENSITY RELATIONSHIP

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: ____ day ____ month ____ year

MATERIAL TYPE: _____ SAMPLE NO.: _____



SUMMARY OF TEST RESULTS	
TEST STANDARD (CIRCLE ONE)	ASTM D 698 A, B, C ASTM D 1557 A, B, C
MAXIMUM DRY UNIT WEIGHT (pcf)	
OPTIMUM MOISTURE CONTENT (%)	
SAMPLE DESCRIPTION	
SOURCE	
QA ID:	

GeoSyntec Consultants

FLUOR DANIEL FERNALD

FIELD LABORATORY COMPACTION TEST (ASTM D 1557 METHOD C)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

MATERIAL TYPE: _____ SAMPLE NO.: _____

THIS METHOD WILL BE USED IF THE MATERIAL RETAINED ON THE NO. 3/4-in. (19-mm) SIEVE IS LESS THAN 30%, IF THE MATERIAL RETAINED ON THE NO. 4 (4.75-mm) SIEVE IS GREATER THAN 20%, AND IF THE MATERIAL RETAINED ON THE NO. 3/8-in. (9.5-mm) SIEVE IS LESS THAN 20%. ALL MATERIAL RETAINED ON THE NO. 3/8 in. (9.5-MM) SIEVE IS DISCARDED. USE OVERSIZE CORRECTION IF MORE THAN 5% IS DISCARDED ACCORDING TO ASTM D 4718. USE A 4-in. DIAMETER MOLD / 5.5 lb RAMMER / 12-in. DROP / 3 LAYERS / 25 BLOWS PER LAYER.

COMPACTION OF SOIL

QA ID: _____

	WATER ADDED	(ml)					
A	WT. OF SOIL & MOLD	(grams)					
B	WT. OF MOLD	(grams)					
C	WT. OF SOIL = A - B	(grams)					
D	WET UNIT WT.(1) = C X 0.066	(pcf)					
E	DRY UNIT WT. = D / [1 + (K/100)]	(pcf)					

NOTE: IF CALIBRATED MOLD OF 1/30 FT IS USED, THE WET DENSITY IS CALCULATED FROM THE WEIGHT OF SOIL, THE VOLUME OF THE MOLD AND THE CONVERSION FROM GRAMS TO POUNDS (I.E., CONVERSION FACTOR = (30 / 453.6) = 0.066). THE MOLD MUST BE CALIBRATED TO VERIFY A CAPACITY OF 1/30 ± 0.0005 FT^3 ON INTERVALS NOT TO EXCEED 1000 TIMES THAT THE MOLD IS FILLED.

MOISTURE CONTENT - ASTM D 2216

QA ID: _____

	TARE NO.						
F	WT. OF TARE	(grams)					
G	WT. OF WET SOIL & TARE	(grams)					
H	WT. OF DRY SOIL & TARE	(grams)					
I	WT. OF WATER = G - H	(grams)					
J	WT. DRY SOIL = H - F	(grams)					
K	MOISTURE CONTENT = (I/J) X 100	(%)					

GeoSyntec Consultants

FLUOR DANIEL FERNALD

FIELD LABORATORY COMPACTION TEST (ASTM D 1557 METHODS A, B, AND C)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

MATERIAL TYPE: _____ SAMPLE NO.: _____

THIS METHOD WILL BE USED IF THE MATERIAL RETAINED ON THE NO. 3/4-in. (19-mm) SIEVE IS LESS THAN 30%, IF THE MATERIAL RETAINED ON THE NO. 4 (4.75-mm) SIEVE IS GREATER THAN 20%, AND IF THE MATERIAL RETAINED ON THE NO. 3/8-in. (9.5-mm) SIEVE IS LESS THAN 20%. ALL MATERIAL RETAINED ON THE NO. 3/8 in. (9.5-MM) SIEVE IS DISCARDED. USE OVERSIZE CORRECTION IF MORE THAN 5% IS DISCARDED ACCORDING TO ASTM D 4718. USE A 4-in. DIAMETER MOLD / 5.5 lb RAMMER / 12-in. DROP / 3 LAYERS / 25 BLOWS PER LAYER.

COMPACTION OF SOIL

QA ID: _____

	WATER ADDED	(ml)					
A	WT. OF SOIL & MOLD	(grams)					
B	WT. OF MOLD	(grams)					
C	WT. OF SOIL = A - B	(grams)					
D	WET UNIT WT.[1] = C X 0.066	(pcf)					
E	DRY UNIT WT. = D / [1 + (K/100)]	(pcf)					

NOTE: IF CALIBRATED MOLD OF 1/30 FT IS USED, THE WET DENSITY IS CALCULATED FROM THE WEIGHT OF SOIL, THE VOLUME OF THE MOLD AND THE CONVERSION FROM GRAMS TO POUNDS (I.E., CONVERSION FACTOR = (30 / 453.6) = 0.066). THE MOLD MUST BE CALIBRATED TO VERIFY A CAPACITY OF 1/30 ± 0.0005 FT^3 ON INTERVALS NOT TO EXCEED 1000 TIMES THAT THE MOLD IS FILLED.

MOISTURE CONTENT - ASTM D 2216

QA ID: _____

	TARE NO.						
F	WT. OF TARE	(grams)					
G	WT. OF WET SOIL & TARE	(grams)					
H	WT. OF DRY SOIL & TARE	(grams)					
I	WT. OF WATER = G - H	(grams)					
J	WT. DRY SOIL = H - F	(grams)					
K	MO CONTENT = (I/J) X 100	(%)					

GeoSyntec Consultants

FLUOR DANIEL FERNALD

FIELD LABORATORY COMPACTION TEST (ASTM D 1557 METHOD A)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

MATERIAL TYPE: _____ SAMPLE NO.: _____

THIS METHOD WILL BE USED IF THE MATERIAL RETAINED ON THE NO. 3/4-in. (19-mm) SIEVE IS LESS THAN 30%, IF THE MATERIAL RETAINED ON THE NO. 4 (4.75-mm) SIEVE IS GREATER THAN 20%, AND IF THE MATERIAL RETAINED ON THE NO. 3/8-in. (9.5-mm) SIEVE IS LESS THAN 20%. ALL MATERIAL RETAINED ON THE NO. 3/8 in. (9.5-MM) SIEVE IS DISCARDED. USE OVERSIZE CORRECTION IF MORE THAN 5% IS DISCARDED ACCORDING TO ASTM D 4718. USE A 4-in. DIAMETER MOLD / 5.5 lb RAMMER / 12-in. DROP / 3 LAYERS / 25 BLOWS PER LAYER.

COMPACTION OF SOIL

QA ID: _____

	WATER ADDED	(ml)					
A	WT. OF SOIL & MOLD	(grams)					
B	WT. OF MOLD	(grams)					
C	WT. OF SOIL = A - B	(grams)					
D	WET UNIT WT.(1) = C X 0.066	(pcf)					
E	DRY UNIT WT. = D / [1 + (K/100)]	(pcf)					

NOTE: IF CALIBRATED MOLD OF 1/30 FT IS USED, THE WET DENSITY IS CALCULATED FROM THE WEIGHT OF SOIL, THE VOLUME OF THE MOLD AND THE CONVERSION FROM GRAMS TO POUNDS (I.E., CONVERSION FACTOR = (30 / 453.6) = 0.066). THE MOLD MUST BE CALIBRATED TO VERIFY A CAPACITY OF 1/30 ± 0.0005 FT^3 ON INTERVALS NOT TO EXCEED 1000 TIMES THAT THE MOLD IS FILLED.

MOISTURE CONTENT - ASTM D 2216

QA ID: _____

	TARE NO.						
F	WT. OF TARE	(grams)					
G	WT. OF WET SOIL & TARE	(grams)					
H	WT. OF DRY SOIL & TARE	(grams)					
I	WT. OF WATER = G - H	(grams)					
J	WT. DRY SOIL = H - F	(grams)					
K	MOISTURE CONTENT = (I/J) X 100	(%)					

GeoSyntec Consultants

FLUOR DANIEL FERNALD

FIELD LABORATORY COMPACTION TEST (ASTM D 698 METHOD C)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

MATERIAL TYPE: _____ SAMPLE NO.: _____

THIS METHOD WILL BE USED IF THE MATERIAL RETAINED ON THE NO. 3/4-in. (19-mm) SIEVE IS LESS THAN 30%, IF THE MATERIAL RETAINED ON THE NO. 4 (4.75-mm) SIEVE IS GREATER THAN 20%, AND IF THE MATERIAL RETAINED ON THE NO. 3/8-in. (9.5-mm) SIEVE IS LESS THAN 20%. ALL MATERIAL RETAINED ON THE NO. 3/8 in. (9.5-MM) SIEVE IS DISCARDED. USE OVERSIZE CORRECTION IF MORE THAN 5% IS DISCARDED ACCORDING TO ASTM D 4718. USE A 4-in. DIAMETER MOLD / 5.5 lb RAMMER / 12-in. DROP / 3 LAYERS / 25 BLOWS PER LAYER.

COMPACTION OF SOIL

QA ID: _____

	WATER ADDED	(ml)					
A	WT. OF SOIL & MOLD	(grams)					
B	WT. OF MOLD	(grams)					
C	WT. OF SOIL = A - B	(grams)					
D	WET UNIT WT.(1) = C X 0.066	(pcf)					
E	DRY UNIT WT. = D / [1 + (K/100)]	(pcf)					

NOTE: IF CALIBRATED MOLD OF 1/30 FT IS USED, THE WET DENSITY IS CALCULATED FROM THE WEIGHT OF SOIL, THE VOLUME OF THE MOLD AND THE CONVERSION FROM GRAMS TO POUNDS (I.E., CONVERSION FACTOR = (30 / 453.6) = 0.066). THE MOLD MUST BE CALIBRATED TO VERIFY A CAPACITY OF 1/30 ± 0.0005 FT^3 ON INTERVALS NOT TO EXCEED 1000 TIMES THAT THE MOLD IS FILLED.

MOISTURE CONTENT - ASTM D 2216

QA ID: _____

	TARE NO.						
F	WT. OF TARE	(grams)					
G	WT. OF WET SOIL & TARE	(grams)					
H	WT. OF DRY SOIL & TARE	(grams)					
I	WT. OF WATER = G - H	(grams)					
J	WT. DRY SOIL = H - F	(grams)					
K	MC CONTENT = (I/J) X 100	(%)					

GeoSyntec Consultants

FLUOR DANIEL FERNALD

FIELD LABORATORY COMPACTION TEST (ASTM D 698 METHOD B)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

MATERIAL TYPE: _____ SAMPLE NO.: _____

THIS METHOD WILL BE USED IF THE MATERIAL RETAINED ON THE NO. 3/4-in. (19-mm) SIEVE IS LESS THAN 30%, IF THE MATERIAL RETAINED ON THE NO. 4 (4.75-mm) SIEVE IS GREATER THAN 20%, AND IF THE MATERIAL RETAINED ON THE NO. 3/8-in. (9.5-mm) SIEVE IS LESS THAN 20%. ALL MATERIAL RETAINED ON THE NO. 3/8 in. (9.5-MM) SIEVE IS DISCARDED. USE OVERSIZE CORRECTION IF MORE THAN 5% IS DISCARDED ACCORDING TO ASTM D 4718. USE A 4-in. DIAMETER MOLD / 5.5 lb RAMMER / 12-in. DROP / 3 LAYERS / 25 BLOWS PER LAYER.

COMPACTION OF SOIL

QA ID: _____

	WATER ADDED	(ml)					
A	WT. OF SOIL & MOLD	(grams)					
B	WT. OF MOLD	(grams)					
C	WT. OF SOIL = A - B	(grams)					
D	WET UNIT WT.(1) = C X 0.066	(pcf)					
E	DRY UNIT WT. = D / [1 + (K/100)]	(pcf)					

NOTE: IF CALIBRATED MOLD OF 1/30 FT IS USED, THE WET DENSITY IS CALCULATED FROM THE WEIGHT OF SOIL, THE VOLUME OF THE MOLD AND THE CONVERSION FROM GRAMS TO POUNDS (I.E., CONVERSION FACTOR = (30 / 453.6) = 0.066). THE MOLD MUST BE CALIBRATED TO VERIFY A CAPACITY OF 1/30 ± 0.0005 FT^3 ON INTERVALS NOT TO EXCEED 1000 TIMES THAT THE MOLD IS FILLED.

MOISTURE CONTENT - ASTM D 2216

QA ID: _____

	TARE NO.						
F	WT. OF TARE	(grams)					
G	WT. OF WET SOIL & TARE	(grams)					
H	WT. OF DRY SOIL & TARE	(grams)					
I	WT. OF WATER = G - H	(grams)					
J	WT. DRY SOIL = H - F	(grams)					
K	MOISTURE CONTENT = (I/J) X 100	(%)					

GeoSyntec Consultants

FLUOR DANIEL FERNALD

FIELD LABORATORY COMPACTION TEST (ASTM D 698 METHOD A)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

MATERIAL TYPE: _____ SAMPLE NO.: _____

THIS METHOD WILL BE USED IF THE MATERIAL RETAINED ON THE NO. 3/4-in. (19-mm) SIEVE IS LESS THAN 30%, IF THE MATERIAL RETAINED ON THE NO. 4 (4.75-mm) SIEVE IS GREATER THAN 20%, AND IF THE MATERIAL RETAINED ON THE NO. 3/8-in. (9.5-mm) SIEVE IS LESS THAN 20%. ALL MATERIAL RETAINED ON THE NO. 3/8 in. (9.5-MM) SIEVE IS DISCARDED. USE OVERSIZE CORRECTION IF MORE THAN 5% IS DISCARDED ACCORDING TO ASTM D 4718. USE A 4-in. DIAMETER MOLD / 5.5 lb RAMMER / 12-in. DROP / 3 LAYERS / 25 BLOWS PER LAYER.

COMPACTION OF SOIL

QA ID: _____

	WATER ADDED	(ml)					
A	WT. OF SOIL & MOLD	(grams)					
B	WT. OF MOLD	(grams)					
C	WT. OF SOIL = A - B	(grams)					
D	WET UNIT WT.(1) = C X 0.066	(pcf)					
E	DRY UNIT WT. = D / [1 + (K/100)]	(pcf)					

NOTE: IF CALIBRATED MOLD OF 1/30 FT IS USED, THE WET DENSITY IS CALCULATED FROM THE WEIGHT OF SOIL, THE VOLUME OF THE MOLD AND THE CONVERSION FROM GRAMS TO POUNDS (I.E., CONVERSION FACTOR = (30 / 453.6) = 0.066). THE MOLD MUST BE CALIBRATED TO VERIFY A CAPACITY OF 1/30 ± 0.0005 FT^3 ON INTERVALS NOT TO EXCEED 1000 TIMES THAT THE MOLD IS FILLED.

MOISTURE CONTENT - ASTM D 2216

QA ID: _____

	TARE NO.						
F	WT. OF TARE	(grams)					
G	WT. OF WET SOIL & TARE	(grams)					
H	WT. OF DRY SOIL & TARE	(grams)					
I	WT. OF WATER = G - H	(grams)					
J	WT. DRY SOIL = H - F	(grams)					
K	MOISTURE CONTENT = (I/J) X 100	(%)					

GeoSyntec Consultants

FLUOR DANIEL FERNALD

LABORATORY DETERMINATION OF MOISTURE CONTENT OF SOIL

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: ____ day ____ month ____ year

MATERIAL TYPE: _____ SAMPLE NO.: _____

OVEN METHOD (ASTM D 2216): Recommended Mass Of Moist Sample Weight QA ID: _____

100% PASING THE NO. 10 (2-mm) SIEVE	20 grams
100% PASSING THE NO. 4 (4.75-mm) SIEVE	100 grams
100% PASSING THE NO. 3/8-in. (9.5-mm) SIEVE	500 grams
100% PASSING THE NO. 3/4-in. (19-mm) SIEVE	2.5 kilograms

	TARE NO. _____					
A	WT. OF TARE					
B	WT. OF WET SOIL & TARE					
C	WT. OF DRY SOIL & TARE					
D	WT. OF WATER = B-C					
E	WT. OF DRY SOIL = C-A					
F	MOISTURE CONTENT = (D/E) X 100					

MICROWAVE METHOD (ASTM D 4643): Recommended Mass Of Moist Sample Weight QA ID: _____

90% PASSING THE NO. 10 (2-mm) SIEVE	100 TO 200 grams
90% PASSING THE NO. 4 (4.75-mm) SIEVE	200 TO 500 grams
90% PASSING THE 3/4-in. (19-mm) SIEVE	500 TO 1000 grams

INITIAL SETTING TO BE AT 3.0 MINUTES, CONTINUE DRYING SAMPLE AT 1.0 MINUTE SETTING UNTIL MOISTURE CONTENT VARIATION BETWEEN SETTINGS IS LESS THAN 0.1%

	TARE NO.					
A	WT. OF TARE					
B	WT. OF WET SOIL & TARE					
C	WT. OF DRY SOIL & TARE					
D	WT. OF WATER = B-C					
E	WT. OF DRY SOIL = C-A					
F	MOISTURE CONTENT = (D/E) X 100					

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

PERCENT OF SOIL FINER THAN NO. 200 SIEVE (ASTM D 1140)

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: ____ day ____ month ____ year

MATERIAL TYPE: _____

SOIL SAMPLE SIZE ASTM D 1140			SAMPLE NO.: _____
NOMINAL DIAMETER OF LARGEST PARTICLE (SIEVE)	NO. 10	NO. 4	3/4 in.
APPROXIMATE MINIMUM WT. OF SAMPLE (g)	200	500	1500

QA ID: _____

A	WT. OF TARE NO. _____	(g)	
B	WT. OF DRY SOIL BEFORE WASH PLUS TARE	(g)	
C	WT. OF DRY SOIL BEFORE WASH = B - A	(g)	
D	WT. OF DRY SOIL AFTER WASH PLUS TARE	(g)	
E	WT. OF DRY SOIL AFTER WASH = D - A	(g)	
F	WT. OF DRY SOIL WASHED THROUGH NO. 200 = C - E	(g)	
G	PERCENT OF SOIL FINER THAN NO. 200 SIEVE = (F/C)x100	(%)	

NOTES:

GeoSyntec Consultants

FLUOR DANIEL FERNALD

SOIL SAMPLE LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ YEAR: _____

SITE SAMPLE NO.	OFF-SITE LAB SAMPLE NO.	VISUAL DESCRIPTION	SOURCE (LOCATION/DEPTH)	MATERIAL TYPE	DATE SAMPLED (day/mo)	TEST METHODS	QA ID

NOTES: _____

_____

©GeoSyntec Consultants FILE NO. 2-01-SSL CHECKED BY: _____ SHEET NO. _____ OF _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

FIELD RELEASE FORM

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: YEAR:

As of .....(day).....(month).....(year), the field services operation provided by Geosyntec Consultants for the project is complete, except for the following:

The Owner's representative authorizes GeoSyntec Consultants to demobilize its on-site personnel providing the following conditions are met:

OWNER'S REPRESENTATIVE day/mo/yr

SITE COA MANAGER day/mc

PROJECT MANAGER day/mo/yr

COPY TO:

GeoSyntec Consultants

FLUOR DANIEL FERNALD

COMPRESSIVE STRENGTH TEST OF CONCRETE SPECIMANS

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: ____ day ____ month ____ year

DESIGN MIX DATA: DESIGN MIX NO.: _____ AIR CONTENT(%): _____

COMPRESSIVE STRENGTH: _____ (psi) AT _____ (days) SLUMP RANGE(in.): _____ to _____

FIELD AND LABORATORY: CONCRETE SUPPLIER: CONTRACTOR:

LOCATION OF PLACEMENT:

CONCRETE TRUCK NO.: TICKET NUMBER:

SIZE OF LOAD (yd^3): AMBIENT TEMPERATURE (F/C):

TIME BATCHED: CONCRETE TEMPERATURE (F/C):

DATE SAMPLED: SLUMP (in.):

TIME SAMPLED: AIR CONTENT (% by Vol.):

TIME COMPLETED: WET WEIGHT (lb/ft^3):

TESTING LABORATORY:

Field Sample No.	Laboratory Sample No.	Age (days)	Total Load	Area (in^2)	Compressive Strength (psi)	Pass/Fail	QA ID

COPY TO: _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

CONCRETE PLACEMENT FORM

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

DESIGN MIX DATA: DESIGN MIX NO.: _____

COMPRESSIVE STRENGTH: _____ (psi) AT _____ (days) SLUMP RANGE (in.): _____ to _____ AIR CONTENT (%): _____

FIELD AND LABORATORY: CONCRETE SUPPLIER: _____ TESTING LABORATORY _____

TRUCK NO.	TICKET NO.	SIZE OF LOAD (yd^3)	TIME				LOCATION	TEMPERATURE		TESTING					
			LOAD BATCHED	BEGIN PLACEMENT	FINISH PLACEMENT	SAMPLED		AMBIENT (°F/C)	ASTM C-1064 CONCRETE (°F/C)	WATER ADDED (gal)	ASTM C-143 SLUMP (in.)	ASTM C-173 AIR CONTENT (%)	PASS/ FAIL	QA ID	NO. OF CYLINDERS

LOCATION NOTES: _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

PRESSURE TEST LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ YEAR: _____

CONTRACTOR: _____

TEST DESCRIPTION: _____

MATERIAL DESCRIPTION: FORCEMAIN: ☐ CONTAINMENT: ☐ MANHOLE: ☐ OTHER: ☐

TEST LOCATION: _____

READING NO.	DATE (day/mo)	TIME	READING	CHANGE IN READING	QA ID

VISUAL MONITORING: _____ _____

CONTRACTOR'S REPRESENTATIVE day/mo/yr SITE CQA MANAGER day/mo/yr

FINAL APPROVAL: _____ _____

CONTRACTOR'S REPRESENTATIVE day/mo/yr SITE CQA MANAGER day/mo/yr

COPY TO: _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

SITE SAFETY FORM

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: ____ day ____ month ____ year

CONTRACTOR: _____

DURING THE COURSE OF PERFORMING OUR DUTIES ON THIS PROJECT, WE HAVE BECOME AWARE OF A POTENTIALLY DANGEROUS SITUATION ON THE SITE. WHILE WE SPECIFICALLY ASSUME NO RESPONSIBILITY FOR JOB SITE SAFETY, WE ARE BRINGING THIS TO YOUR ATTENTION AS A COURTESY TO OUR CLIENT.

THIS POTENTIALLY DANGEROUS SITUATION IS OF THE FOLLOWING NATURE (AS CHECKED):

- ☐ IMPROPERLY BRACED OR SLOPED EXCAVATIONS THAT ARE DEEPER THAN FIVE FEET
- ☐ IMPROPER ENTRY INTO CONFINED SPACE
- ☐ POTENTIAL EXPOSURE OF PERSONNEL TO HAZARDOUS SUBSTANCES OR HAZARDOUS WASTES
- ☐ LACK OF PROPER PROTECTIVE EQUIPMENT
- ☐ OTHER: .....

DESCRIPTION AND LOCATION OF THE WORK AREA:

SKETCH OF THE WORK AREA

SUBMITTED BY:

_____ OF GEOSYNTEC CONSULTANTS _____ DATE

ACKNOWLEDGED BY:

_____ OF _____ DATE

_____ OF _____ DATE

_____ OF _____ DATE

GeoSyntec Consultants

FLUOR DANIEL FERNALD

SURVEY DATA LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

SURVEYOR: _____ ALLOWABLE TOLERANCE: _____ QA ID: _____

SURVEY POINT NO.	LOCATION		ELEVATION (TOP OF)						DEPTH OF ZONE			
									___ in. MIN	___ in. MIN	___ in. MIN	___ in. MIN
	NORTH	EAST										

GeoSyntec Consultants FILE NO. 1-16-SDL

SHEET NO. _____ OF _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

PHOTOGRAPHIC LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: YEAR:

REFERENCE NO.	DATE (day/month)	DESCRIPTION

GeoSyntec Consultants

FLUOR DANIEL FERNALD

MEETING SIGN-IN SHEET

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

SUBJECT: _____ REFERENCE NO. _____

NAME	ORGANIZATION	TELEPHONE

NOTE: FOR FIRST TIME ATTENDEES, PLEASE ATTACH A BUSINESS CARD.

GeoSyntec Consultants

FLUOR DANIEL FERNALD

SUBMITTAL LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.:

DESCRIPTION: YEAR:

CONTRACTOR:

SUBMITTAL NUMBER	SUBMITTAL TITLE	REVISION	DATE SUBMITTED (day/mo)	DATE REVIEWED (day/mo)	RE-SUBMIT YES	RE-SUBMIT NO	DATE APPROVED (day/mo)	COMMENTS

GeoSyntec Consultants

FLUOR DANIEL FERNALD

SUBMITTAL COVER SHEET

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: YEAR:

CONTRACTOR:

SUBMITTAL NO.: REVISION NO.:

SUBMITTAL TITLE:

SPECIFICATION SECTION: CQA PLAN SECTION:

DATE SUBMITTED: (day/ month/ year) DATE REVIEWED: (day/ month/ year)

RESUBMITTAL REQUIRED: ☐ YES ☐ NO

DATE APPROVED: (day/ month/ year)

COMMENTS:

DISTRIBUTION:

PREPARED BY:

APPROVED BY:

JOR DANIEL
RNALD

PROJECT NO.: G00166 TASK NO.:

YEAR:

COMMENTS

SHEET NO OF

GeoSyntec Consultants

FLUOR DANIEL FERNALD

CLARIFICATION FORM

REFERENCE NO.: _____

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

OWNER: _____

REFERENCES:

SPECIFICATION SECTION: CQA PLAN SECTION:

CLARIFICATION:

REQUESTED BY: _____ DATE: _____
(SIGNATURE AND TITLE) (day/mo/year)

RESPONSE:

RESPONDED BY: _____ DATE: _____
(SIGNATURE AND TITLE) (day/mo/year)

COPY TO: _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

CHANGE ORDER (CO) REFERENCE NO.: _____

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: ____ day ____ month ____ year

FINANCIAL IMPACT:	YES		NO		NA	SCHEDULE IMPACT:	YES	NO	NA
SAVINGS:	YES	EST. $		NO		SAVINGS:	YES	EST. DAYS	NO
COST:	YES	EST. $		NO		DELAY:	YES	EST. DAYS	NO

REFERENCES:

SPECIFICATION SECTION: CQA PLAN SECTION:

MATERIAL TYPE:

ITEM BEING CHANGE OR ADDED:

REASON FOR CHANGE:

EFFECTIVE DATE OF THE CHANGE (day) (mo) (year)

FINANCIAL AND SCHEDULE CONSIDERATIONS

OWNER'S REPRESENTATIVE day/mo/yr

SITE CQA MANAGER day/m

PROJECT MANAGER day/mo/yr

COPY TO: _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

TRANSMITTAL LETTER

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: ____ day ____ month ____ year

ATTENTION: _____

ADDRESS: _____

_____

☐ FOR APPROVAL	☐ PRINTS	☐ TEST RESULTS	☐ _____
☐ FOR COMMENTS	☐ PHOTOS	☐ DOCUMENTS	☐ _____
☐ AS REQUESTED	☐ LOGS	☐ CONTRACTS	☐ _____

NO. OF COPIES	DRAWING NUMBER	DESCRIPTION	DATE

REMARKS

COPY TO: _____ FROM: _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

FIELD OBSERVATION REPORT

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: ____ day ____ month ____ year

WEATHER: _____

AREA:

CONTRACTOR:

EQUIPMENT USED:

WORK PERFORMED:

COPY TO: _____ PER: _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

WEEKLY FIELD REPORT

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ WEEK ENDING: _____

COPY TO: _____ PER: _____

GeoSyntec Consultants

FLUOR DANIEL FERNALD

PERSONNEL/EQUIPMENT DAILY LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: WEEK BEGINING:

ITEM	REF ID	COMPANY	MON	TUES	WED	THURS	FRI	SAT	SUN

GeoSyntec Consultants

FLUOR DANIEL FERNALD

SENIOR PERSONNEL SUMMARY LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ YEAR: _____

NAME	REF ID	COMPANY	POSITION	COMMENTS

GeoSyntec Consultants

FLUOR DANIEL FERNALD

DAILY WEATHER LOG

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO.: GQ0166 TASK NO.: _____

DESCRIPTION: _____ DATE: _____ day _____ month _____ year

TIME PERIOD: AM QA ID: _____

GENERAL CONDITIONS: _____ CLEAR _____ LIGHT CLOUD COVER _____ OVERCAST

WIND: _____ LIGHT _____ MODERATE _____ STRONG _____ GUSTY

TEMPERATURE RANGE: _____ °F °C

PRECIPITATION: _____ NONE _____ DRIZZLE/FOG _____ RAIN

COMMENTS: _____

TIME PERIOD: PM QA ID: _____

GENERAL CONDITIONS: _____ CLEAR _____ LIGHT CLOUD COVER _____ OVERCAST

WIND: _____ LIGHT _____ MODERATE _____ STRONG _____ GUSTY

TEMPERATURE RANGE: _____ °F °C

PRECIPITATION: _____ NONE _____ DRIZZLE/FOG _____ RAIN

COMMENTS: _____

TIME A.M.	AMBIENT TEMPERATURE °F °C	GEOMEMBRANE LINER TEMPERATURE °F °C	COMMENTS

TIME P.M.	AMBIENT TEMPERATURE °F °C	GEOMEMBRANE LINER TEMPERATURE °F °C	COMMENTS

NOTE: ('BIENT TEMPERATURE LOCATIONS TAKEN AT APPROXIMATELY . ABOVE GROUND LEVEL.

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

DAILY FIELD REPORT

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: _____ DATE: ____ day ____ month ____ year

CONTRACTOR: _____

WEATHER: _____

COPY TO: _____ PER: _____ HRS: _____

APPENDIX B

TABLE 02770-1
REQUIRED TEXTURED
HDPE GEOMEMBRANE PROPERTIES

TABLE 02770-1

REQUIRED HDPE TEXTURED GEOMEMBRANE PROPERTIES

Properties	Qualifiers	Units[1]	Specified Values		Test Method
			Liner	Cap	
Physical Properties					
Thickness	average	mils	80	60	GRI-GM8
	minimum	mils	76	58	GRI-GM8
Specific Gravity	minimum	N/A	0.940		ASTM D 792 Method A or ASTM D 1505
Carbon Black Content	range	%	2-3		ASTM D 1603
Carbon Black Dispersion	N/A	none	Category 1 or 2		ASTM D 5596
Melt Flow Index	maximum	g/10 min	1.0		ASTM D 1238 (Condition E)
Mechanical Properties					
Tensile Properties (each direction)					
1. Force Per Unit Width at Yield	minimum	lb/in	168	126	ASTM D 638 (Modified by NSF 54 Annex A)
2. Tensile Strength (force per unit width at break)	minimum	lb/in	120	90	ASTM D 638 (Modified by NSF 54 Annex A)
3. Elongation at Yield	minimum	%	12		ASTM D 638 (Modified by NSF 54 Annex A)
4. Elongation at Break	minimum	%	200		ASTM D 638 (Modified by NSF 54 Annex A)
Tear Resistance	minimum	lb	56	42	ASTM D 1004 Die C Puncture

TABLE 02770-1 (continued)

Properties	Qualifiers	Units[1]	Specified Values		Test Method
			Liner	Cap	
Environmental Properties					
Low Temperature Brittleness	maximum	°C	-60		ASTM D 746 Procedure B
Dimensional Stability (each direction)	maximum change	%	±2		ASTM D 1204 212°F, 15 min.
Environmental Stress Crack	minimum	hrs	500[2]		ASTM D 5397

Notes: 1. % = percent
g = grams
min = minutes
lb/in = pounds per inch
lb = pound
°C = degrees celsius
hrs = hours
2. Time-to-failure at a tensile stress of 30 percent of the tensile yield strength.

APPENDIX C

TABLE 02772-1
REQUIRED GEOSYNTHETIC CLAY LINER AND CAP PROPERTY VALUES

TABLE 02772-1

REQUIRED GEOSYNTHETIC CLAY LINER AND CAP PROPERTY VALUES

PROPERTIES	QUALIFIERS	UNITS[6]	SPECIFIED[1] VALUES	TEST METHOD
GCL Properties				
Bentonite Content[2] (GCL)	minimum	lb/ft^2	1.0	ASTM D 5261
Bentonite Moisture Content	maximum	%	25	ASTM D 4643
Bentonite Free Swell	minimum	ml/2g	24	ASTM D 5890
Hydraulic Conductivity (Bentonite only)[3]	minimum	cm/s	5×10^{-9}	GRI GCL-2
Shear Strength (GCL)		See values in Part 2 of this Section.		
Textured HDPE Geomembrane Properties[4]				
Thickness	average minimum	mils mils	40 36	GRI GM 8 GRI GM 8
Specific Gravity	minimum	N/A	0.94	ASTM D 792 or ASTM 1505
Melt Flow Index	maximum	g/10 min	1.0	ASTM D 1238 (Condition E)
Elongation at Yield	minimum	%	13	ASTM D 638
Elongation at Break	minimum	%	100	ASTM D 638
Strength at Yield	minimum	lb/in	95	ASTM D 638
Strength at Break	minimum	lb/in	50	ASTM D 638
Tear Resistance	minimum	lb	12	ASTM D 1004 Die C puncture
Puncture Resistance	minimum	lb	25	ASTM D 4833
Carbon Black Content	range	%	2-3	ASTM D 1603
Carbon Black Dispersion	N/A	none	Category 1 or 2	ASTM D 5596
Geotextile Properties[4]				
Polymer Composition	minimum	%	95 polyester or polypropylene	

APPENDIX D

TABLES 02714-1 THROUGH 02714-5 REQUIRED PROPERTY VALUES FOR CUSHIONS GEOTEXTILE FILTER AND SEPARATOR

TABLE 02714-1

REQUIRED PROPERTY VALUES FOR GEOTEXTILE FILTER

PROPERTIES	QUALIFIER	UNITS	SPECIFIED[4] VALUES	TEST METHOD
Type				
nonwoven needlepunched				(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd^2	7	ASTM D 5261
Filter Requirements				
Apparent opening size (O_{95})	maximum	mm	0.21	ASTM D 4751
Permittivity	minimum	sec^{-1}	0.5	ASTM D 4491
Mechanical Requirements				
Grab strength	minimum	lb	180	ASTM D 4632[1]
Tear strength	minimum	lb	75	ASTM D 4533[2]
Puncture strength	minimum	lb	75	ASTM D 4833[3]
Burst strength	minimum	psi	350	ASTM D 3786
Durability				
Ultraviolet Resistance	minimum	%	70	ASTM D 4355

Notes:

(1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(2) Minimum value measured in machine and cross machine direction.
(3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(4) All values represent minimum average roll values.
(5) mm = millimeter
% = percent
oz/yd^2 = ounce per square yard
sec = second
lb = pound
psi = pound per square inch

TABLE 02714-2

REQUIRED PROPERTY VALUES FOR GEOTEXTILE CUSHION IN FINAL COVER SYSTEM

PROPERTIES	QUALIFIER	UNITS	SPECIFIED[4] VALUES	TEST METHOD
Type				
nonwoven needlepunched				(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd^2	8	ASTM D 5261
Mechanical Requirements				
Grab strength	minimum	lb	200	ASTM D 4632[1]
Tear strength	minimum	lb	75	ASTM D 4533[2]
Puncture strength	minimum	lb	90	ASTM D 4833[3]
Burst strength	minimum	psi	350	ASTM D 3786
Durability				
Ultraviolet Resistance @ 500 hours	minimum	%	70	ASTM D 4355

Notes:

(1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(2) Minimum value measured in machine and cross machine direction.
(3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(4) All values represent minimum average roll values.
(5) mm = millimeter
% = percent
oz/yd^2 = ounce per square yard
sec = second
lb = pound
psi = pound per square inch

TABLE 02714-3

REQUIRED PROPERTY VALUES FOR GEOTEXTILE CUSHION IN LINER SYSTEM

PROPERTIES	QUALIFIER	UNITS	SPECIFIED[4] VALUES	TEST METHOD
Type				
nonwoven needlepunched				(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd^2	10	ASTM D 5261
Mechanical Requirements				
Grab strength	minimum	lb	225	ASTM D 4632[1]
Tear strength	minimum	lb	90	ASTM D 4533[2]
Puncture strength	minimum	lb	120	ASTM D 4833[3]
Burst strength	minimum	psi	450	ASTM D 3786
Durability				
Ultraviolet Resistance	minimum	%	70	ASTM D 4355

Notes:

(1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(2) Minimum value measured in machine and cross machine direction.
(3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(4) All values represent minimum average roll values.
(5) mm = millimeter
% = percent
oz/yd^2 = ounce per square yard
sec = second
lb = pound
psi = pound per square inch

TABLE 02772-1 (continued)

Notes:
1. All values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table).
2. Measured at a moisture content not exceeding 25 percent.
3. For GCL with geomembrane backing, perforate or cut backing to allow unimpeded and uniform flow through the backing.
4. Geosynthetic clay liners and caps not having these components and otherwise satisfying Part 2.01 of this Section, are exempt from meeting the specified values.
5. Not used.
6. lb/ft^2 = pounds per square foot
   cm/s = centimeter per second
   min = minutes
   g = grams
   % = percent
   lb = pound
   lb/in = pounds per inch
   ml/2g = milliliters per two grams

[END OF SECTION]

TABLE 02714-4

REQUIRED PROPERTY VALUES FOR SUPPLEMENTAL GEOTEXTILE CUSHION IN LINER SYSTEM

PROPERTIES	QUALIFIER	UNITS	SPECIFIED[4] VALUES	TEST METHOD
Type				
nonwoven needlepunched				(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd^2	16	ASTM D 5261
Mechanical Requirements				
Grab strength	minimum	lb	350	ASTM D 4632[1]
Tear strength	minimum	lb	120	ASTM D 4533[2]
Puncture strength	minimum	lb	180	ASTM D 4833[3]
Burst strength	minimum	psi	700	ASTM D 3786
Durability				
Ultraviolet Resistance	minimum	%	70	ASTM D 4355

Notes:

(1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(2) Minimum value measured in machine and cross machine direction.
(3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(4) All values represent minimum average roll values.
(5) mm = millimeter
% = percent
oz/yd^2 = ounce per square yard
sec = second
lb = pound
psi = pound per square inch

TABLE 02714-5

REQUIRED PROPERTY VALUES FOR GEOTEXTILE SEPARATOR

PROPERTIES	QUALIFIER	UNITS	SPECIFIED[4] VALUES	TEST METHOD
Type				
nonwoven				(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd^2	6	ASTM D 5261
Mechanical Requirements				
Grab strength	minimum	lb	180	ASTM D 4632[1]
Tear strength	minimum	lb	75	ASTM D 4533[2]
Puncture strength	minimum	lb	75	ASTM D 4833[3]
Burst strength	minimum	psi	350	ASTM D 3786
Durability				
Ultraviolet Resistance	minimum	%	70	ASTM D 4355

Notes:

(1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(2) Minimum value measured in machine and cross machine direction.
(3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(4) All values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table).
(5) mm = millimeter
% = percent
oz/yd^2 = ounce per square yard
sec = second
lb = pound
psi = pound per square inch

[END OF SECTION]